Programmatic Environmental Assessment for Federally Regulated Offshore Oil and Gas Activities in the Southern California Planning Area

Prepared by Argonne National Laboratory
August 2018

Bureau of Safety and Environmental Enforcement, Pacific OCS Region and Bureau of Ocean Energy Management, Pacific OCS Region

BSEE
Bureau of Safety and Environmental Enforcement

BOEM
Bureau of Ocean Energy Management

CONTENTS

CONTENTS (Cont.)

CONTENTS (Cont.)

FIGURES

TABLES

TABLES (Cont.)

NOTATION

The following is a list of acronyms, abbreviations, and units of measure used in this document. Some acronyms used only in tables may be defined only in those tables.

GENERAL ACRONYMS AND ABBREVIATIONS

APD	Application for Permit to Drill
APM	Application for Permit to Modify
ARB	Air Resources Board
BCC	bird of conservation concern
BOEM	Bureau of Ocean Energy Management
BOP	Blowout Preventer
BSEE	Bureau of Safety and Environmental Enforcement
C	candidate
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
CDFW	California Department of Fish and Wildlife
CDO	California District Office
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
COA	corresponding onshore area
CWA	Clean Water Act
DOI	U.S. Department of the Interior
DMR	Discharge Monitoring Report
DPP	Development and Production Plan
DPS	distinct population segment
E	endangered
EA	environmental assessment
EFH	essential fish habitat
EIS	environmental impact statement
EP	Exploration Plan
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act of 1972
ESU	evolutionarily significant unit
eWell	eWell Permitting and Reporting System
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FR	*Federal Register*

GHG	greenhouse gas
GIS	geographic information system
GWP	global warming potential
HAPC	habitat area of particular concern
IHA	Incidental Harassment Authorization
MMPA	Marine Mammal Protection Act
MODU	Mobile offshore drilling unit
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
O&G	oil and gas
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OPD	Office of Production and Development
PEA	Programmatic Environmental Assessment
PFMC	Pacific Fishery Management Council
PM	particulate matter
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	fine particulates less than 2.5 microns in diameter
POCS	Pacific Outer Continental Shelf
POTW	publicly owned treatment works
PTS	permanent threshold shift
ROG	reactive organic gas
SBCAPCD	Santa Barbara County Air Pollution Control District
SCAQMD	South Coast Air Quality Management District
SCB	Southern California Bight
SCC	species of special concern
SCS	southern California steelhead
spp.	species
T	threatened
Tcf	Trillion cubic feet
TTS	temporary threshold shift
TW	Taxa to watch

U.S.C.	*United States Code*
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
VCAPCD	Ventura County Air Pollution Control District
VOC	volatile organic compound
WST	well stimulation treatment

CHEMICALS

CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
H_2S	hydrogen sulfide
HFCs	hydrofluorocarbons
N_2O	nitrous oxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_3	ozone
PAH	polyaromatic hydrocarbon
SO_2	sulfur dioxide
SO_x	sulfur oxides

UNITS OF MEASURE

bbl	barrel(s)
cm	centimeter(s)
dB	decibel
dBa	a-weighted decibel
ft.	foot (feet)
g	gram(s)
gal	gallon(s)
Hz	hertz
in.	inch(es)
km	kilometer(s)
km^2	square kilometer(s)
kHz	kilohertz
m	meter(s)
mi	mile(s)
ppm	parts per million
rms	root-mean-square
s	second
Tcf	trillion cubic feet
µPa	micropascal

EXECUTIVE SUMMARY

ES.1 INTRODUCTION

The Bureau of Safety and Environmental Enforcement (BSEE) proposes to continue to individually review and, if appropriate, approve new permit applications for well drilling, conductor installation, temporary well abandonment, and other permitted downhole activities at oil and gas platforms on the Pacific Outer Continental Shelf (POCS). Accepting, reviewing, and approving these permits would allow for the continued orderly and environmentally sound production of oil and gas from the reservoirs in the POCS leases.

In accordance with the National Environmental Policy Act of 1969 (NEPA), BSEE and the Bureau of Ocean Energy Management (BOEM) (collectively, "the Bureaus") prepared this draft programmatic environmental assessment (PEA) to evaluate the potential environmental impacts of continued BSEE review and approval of permitted oil and gas activities on the POCS. This draft PEA analyzes the potential environmental effects of the activities that could continue to be permitted under the Proposed Action and alternatives.

ES.2 PURPOSE AND NEED FOR THE PROPOSED ACTION

The Bureaus' proposed action is for BSEE to continue to individually review and approve new applications for well drilling, conductor installation, temporary well abandonment, and other permit-requiring downhole activities at platforms on existing leases on the POCS. Reviewing and approving new permit applications would allow for the continued orderly and environmentally sound production of oil and gas from lease areas on the POCS using conventional methods. Although all existing leases on the POCS have completed exploration and are in production, lessees and operators continue to request BSEE permit approvals for drilling new well bores (including sidetracks from existing wells), for the installation of conductors to guide future well drilling, and for a variety of downhole activities associated with enhancing production, well maintenance, and water injection wells. Such activities serve to maintain ongoing production, and potentially provide additional access to new reservoirs or better access to, and production from, residual reserves in the existing fields. Lessees and operators also continue to request permit approvals for the temporary abandonment of wells (e.g., when oil production from the well decreases or becomes financially prohibitive due to temporary declines in oil prices).

ES.3 PROPOSED ACTION AND ALTERNATIVES

This PEA analyzes the following alternatives:

Alternative 1—Proposed Action: Acceptance, Review, and Authorization of Permit Applications for Conductor Installation, Drilling, Temporary Well Abandonment, and Downhole Operations

Under the Proposed Action, BSEE would continue to accept and review Applications for Permits to Drill (APDs) for conductor installation and well drilling, and Applications for Permits to Modify (APMs) for temporary well abandonment and the following downhole work:

- Completion, which includes initial completion of a new or sidetrack well, reperforation without increasing or decreasing an existing perforated zone, modifying perforations with the intent to increase or decrease the perforated zone, and moving the production zone from one location to another within a wellbore;

- Utility Work, which includes converting from an existing well type to a different type (e.g., production to injection), and injecting fluids not previously injected in an existing injection well;

- Workover Operations, which includes change out (replacement) of existing tubing in a well, and repair of well casing for annular pressure remediation or unwanted communication; and

- Enhanced Production Operations, which includes providing artificial lift using gas injection or downhole pumps, and performing well washing and desanding.

Alternative 2—Acceptance, Review, and Authorization of Permit Applications for Conductor Installation, Drilling, Temporary Well Abandonment, and Downhole Operations, with Temporary Time Restrictions for Conductor Installation

Under Alternative 2, BSEE would continue to accept and review APDs and APMs as under the Proposed Action. However, to minimize the potential to affect marine mammals during conductor installation, BSEE would not authorize conductor installation activities during certain times of the year (i.e., when there is the greatest likelihood of marine mammals being in the project area).

Alternative 3—Acceptance, Review, and Authorization of Permit Applications for Drilling, Temporary Well Abandonment, and Downhole Operations

Under this alternative, BSEE would continue to accept and review APDs and APMs as under the Proposed Action, but would no longer accept APDs for new conductor installation, thus avoiding potential impacts from conductor installation. Under this alternative, the numbers of new and sidetrack wells would be similar to those under the Proposed Action. However, new well drilling requiring a conductor would be limited to only platforms with available conductors.

Alternative 4—Acceptance, Review, and Authorization of Permit Applications for Downhole Operations Necessary for Safe Operations or Pollution Prevention

Under Alternative 4, BSEE would no longer accept or approve APDs for conductor installation or drilling, nor most APMs. BSEE would accept and review APMs for downhole operations deemed necessary to ensure safe operations or pollution prevention of currently permitted and ongoing activities. These downhole operations would be limited primarily to temporary well abandonment and casing pressure repair.

Alternative 5—No Action: No Approval of Applications for Permits to Drill or Permits to Modify

Under the No Action Alternative, BSEE would no longer accept or approve APDs or APMs for any activities that currently require permitting, including any APMs for activities related to safety or pollution prevention. This No Action Alternative complies with the NEPA regulations and provides a baseline against which to compare the potential effects of the action alternatives. Ongoing regulatory and statutory requirements would continue to apply, especially those for maintaining safe operations and protecting the environment on the POCS.

Currently, BSEE-permitted activities (mainly downhole operations) and other ongoing activities—such as routine inspection and maintenance, NPDES-permitted operational discharges, and routine support vessel and helicopter traffic—would continue to occur under each of the five alternatives.

ES.4 AFFECTED ENVIRONMENT

The POCS platforms and their associated 38 leases where activities could be permitted represent the project area for the Proposed Action. The geographic scope of the affected environment includes this project area and the surrounding area, to the extent that potential effects from the Proposed Action could extend beyond the project area. The following resources are evaluated in this PEA for potential impacts from implementation of activities that could be permitted under the Proposed Action:

- *Air Quality:* Potential impacts due to emissions from platform- and support-vessel-based internal combustion engines associated with well drilling, conductor installation, downhole operations, and helicopter and ship support traffic.

- *Water Quality:* Potential impacts from turbidity generated during conductor installation and open-water discharge of drilling wastes.

- *Marine Invertebrates (including special status species[1]):* Potential impacts from turbidity generated during conductor installation and open-water discharge of drilling wastes.

[1] Special status species are those species listed and protected under the Endangered Species Act (ESA) and/or the Marine Mammal Protection Act (MMPA).

- *Marine Fish (including special status species) and Essential Fish Habitat:* Potential impacts due to noise from conductor installation, and from turbidity generated during conductor installation and open-water discharge of drilling wastes.

- *Sea Turtles:* Potential impacts from noise during conductor installation, and collisions with support vessels.

- *Marine Birds (including special status species):* Potential impacts from noise during conductor installation.

- *Marine Mammals (including special status species):* Potential impacts from noise during conductor installation, and from collisions with support vessels.

- *Commercial and Recreational Fisheries:* Potential impacts from noise and from turbidity generated during conductor installation and open-water discharge of drilling wastes.

- *Socioeconomics:* None of the activities that could be permitted under the Proposed Action are expected to significantly affect employment, income, State and local tax revenues, population growth, housing, or community and social services. However, under Alternatives 4 and 5 (the No Action Alternative), oil and gas production may decline more rapidly than under the other alternatives, and thus could result in a more rapid decline in employment, income, and State and local tax revenues.

The following resources and socioeconomic conditions are not expected to be affected by the activities that could be permitted under the Proposed Action, and thus were not evaluated in this PEA:

- Geologic resources/seismicity;
- Archeological resources;
- Recreation and tourism;
- Marine protected areas, parks, and preserves;
- Military training areas; and
- Environmental justice.

ES.5 ENVIRONMENTAL CONSEQUENCES

If approved and permitted, conductor installation, drilling, and downhole operations conducted at the POCS platforms have the potential to affect a variety of resources. Potential impacts of these activities would be similar in nature and magnitude between Alternatives 1 and 2, except under Alternative 2 there would be no conductor installation-related impacts during times with restricted conductor installation (Table ES-1). Under Alternative 3 (which completely excludes conductor installation), there would be no conductor-related impacts, and impacts would be limited to those identified for drilling and support vessel traffic. None of the potential impacts identified for activities that could be permitted under Alternatives 1, 2, and 3 would occur under

Alternatives 4 or 5. Given the small number, limited locations, and temporary duration of the activities that are reasonably foreseeable under Alternative 1, none of the alternatives would result in more than short-term, temporary, and localized minor impacts on the environment, with the possible exception of possible moderate impacts on marine mammals from noise during impulsive (hydraulic hammering) conductor installation. Given the temporary, short-term, and highly localized activities that could be permitted under the Proposed Action, the incremental contribution of impacts from the Proposed Action on area resources are not expected to result in significant cumulative impacts when added to past, current, and foreseeable future impacts on these resources.

Oil and gas production on the POCS has been steadily declining over the last 20 years as the reservoirs decline, and production is expected to continue to decline under each of the alternatives. However, in the absence of new drilling and the use of enhanced production measures, production may decline more rapidly under Alternatives 4 and 5 than under the other alternatives. As a result, overall employment, revenue, and State and local taxes could decline more rapidly under Alternatives 4 and 5 than under the other alternatives, although offshore oil and gas extraction is not a large component of the regional economy.

1 INTRODUCTION

1.1 BACKGROUND

The Submerged Lands Act of 1953, as amended (43 *United States Code* [U.S.C.] §§1301 et seq. [67 Stat. 29]) established Federal jurisdiction over submerged lands seaward of State boundaries. The Outer Continental Shelf Lands Act (OCSLA) of 1953, as amended (43 U.S.C. §§1331 et seq.), directs the Secretary of the Interior to establish policies and procedures that expedite exploration and development of the Outer Continental Shelf (OCS) for the production of resources (e.g., oil and natural gas) in a safe and environmentally sound manner. The Secretary oversees the OCS oil and gas program, and under OCSLA is required to balance orderly resource development with protection of the human, marine, and coastal environments while simultaneously ensuring that the public receives an equitable return for these resources. Section 5 of OCSLA grants the Secretary the right to provide for the "prevention of waste and conservation of natural resources" of the OCS.

There are currently 38 active leases in Federal waters on the Pacific OCS (POCS), with associated oil and gas platforms, pipelines, and supporting infrastructure (Figure 1-1). Within these 38 leases, 19 platforms[2] currently produce from 14 oil and gas fields.[3] The first of these platforms was installed in 1967, and the last two platforms were installed in 1989. By comparison, there are eight[4] active nearshore drilling and production facilities in State waters off southern California; these include three platforms and five artificial islands (Figure 1-1).

The Secretary's responsibilities under OCSLA have been delegated to the Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement (BSEE; together with BOEM, the Bureaus), and together they are responsible for ensuring that resource exploration, development, and production activities carried out on the POCS comply with the requirements of OCSLA. BOEM is responsible for the environmentally sound economic development of the nation's offshore resources. BSEE is responsible for safety and environmental oversight of offshore oil and gas operations, including permitting and inspection of offshore oil and gas operations.

---

2 There are 23 total platforms on the POCS: 22 platforms produce oil and gas, and one (Platform Elly) processes but does not produce oil and gas. Among the production platforms, Platform Habitat is currently non-producing. Platforms Grace and Gail have recently ceased production and are entering the decommissioning process, leaving 19 currently operating production platforms on the POCS.

3 An oil or gas field is a region where multiple oil or gas wells are extracting hydrocarbons from subsurface formations. An oil and gas reservoir is a subsurface pool of hydrocarbons (i.e., crude oil and natural gas) contained in porous or fractured rock formations and trapped by overlying rock formations with lower permeability.

4 A ninth nearshore production location in State waters, Platform Holly, ceased production. Its operator, Venoco LLC, filed for bankruptcy in 2016 and is returning the lease and platform to the State of California for decommissioning.

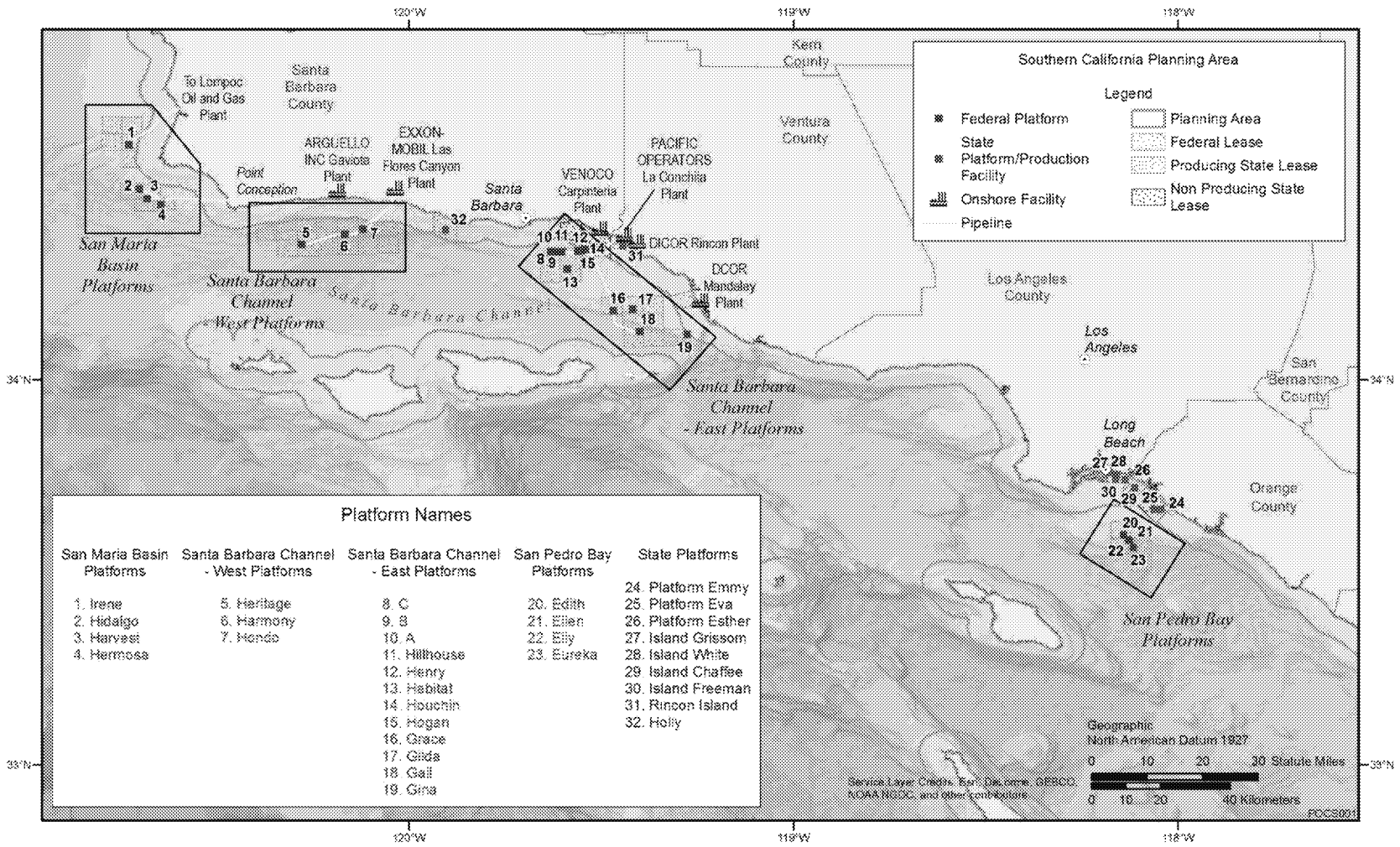

FIGURE 1-1 Locations of Current Leases and Platforms Operating on the POCS (Also shown are platforms and production facilities in nearshore State waters adjacent to the Federal OCS. Platforms in Federal waters are shown and listed in red; those in State waters are indicated in blue. Platform Habitat is currently non-producing. Platforms Gail, Grace, and Holly have initiated decommissioning procedures and are no longer in production.)

1.2 PURPOSE AND NEED FOR THE PROPOSED ACTION

The Bureaus' Proposed Action is to continue to review and individually approve new applications for well drilling, conductor installation, temporary well abandonment, and other permitted downhole activities at platforms on existing leases on the POCS, thereby allowing for continued orderly and environmentally sound production of oil and gas using conventional methods. For leases with active oil and gas production, lessees and platform operators continue to request BOEM and BSEE approvals of activities for drilling new well bores (including sidetracks from existing wells), the installation of conductors to guide future well drilling, and a variety of downhole activities associated with enhancing production, well maintenance, and water injection wells. Such activities serve to maintain ongoing production, and potentially provide additional access to new reservoirs or better access to, and production from, residual reserves in the existing fields. Lessees and operators also continue to request approvals for the temporary abandonment of wells (e.g., when oil production from the well decreases or becomes financially prohibitive due to temporary declines in oil prices).

Oil serves as the feedstock for a variety of liquid hydrocarbon products, among them 32 transportation fuels and various petrochemicals. Natural gas is generally considered an environmentally preferable alternative to other fossil fuels to generate electricity or for residential and industrial heating, and is an important feedstock for manufacturing fertilizers, pharmaceuticals, plastics, and packaging. In 2016, the United States consumed approximately 19.6 million barrels (bbl) of oil per day, of which about 75% was produced domestically and 25% originated from foreign sources (EIA 2017a). In 2016, the United States also consumed about 27.5 trillion cubic feet (Tcf) of natural gas, about 90% of which was produced domestically (EIA 2017b).

1.2.1 Management of OCS Oil and Gas Resources

The Secretary oversees the OCS oil and gas program under OCSLA, and the Bureaus are charged with this oversight. Together, the Bureaus are responsible for safe and effective management of resources on the OCS in accordance with the Secretary's obligations and responsibilities under OCSLA. These responsibilities include conserving OCS resources; balancing orderly resource development with protection of the human, marine, and coastal environments; and ensuring that royalties at fair market value are received by the U.S. Treasury from oil and gas production on active OCS leases (43 U.S.C. 1332(3)).

BOEM functions include offshore oil and gas leasing, resource evaluation, approval of oil and gas exploration plans (EPs) and development and production plans (DPPs), regulating renewable energy development on the OCS, and performing environmental analyses and studies. BOEM develops the National OCS Oil and Natural Gas Leasing Program; oversees assessments of oil, natural gas, and other mineral resource potentials of the OCS; inventories hydrocarbon reserves; develops production projections; and conducts economic evaluations.

BSEE is responsible for enforcing safety and environmental regulations covering the exploration, development, and production of oil and natural gas and other energy and minerals resources on the OCS. BSEE functions include the development and enforcement of offshore safety and

environmental regulations; permitting certain offshore exploration, development, and production activities, such as those related to drilling and pipelines; inspections of offshore oil and gas facilities and operations; and oil spill preparedness. BSEE's permitting authority for these proposed activities is pursuant to the OCSLA implementing regulations at 40 CFR Part 250, subpart D.

1.2.2 Permit Review and Approval

A platform operator interested in new development and production must submit a DPP to BOEM for review and approval. An operator with an approved DPP must submit an Application for Permit to Drill (APD) to BSEE for approval before commencing any of the activities in the approved DPP (for this programmatic environmental assessment [PEA], conductor installation and drilling are the only development and production activities evaluated). BSEE applies criteria in its regulations to reach a permitting decision and to provide any applicable mitigation measures or conditions of approval (see 30 CFR Part 250), and may approve, approve with modifications or mitigation, or deny the APD.

BSEE also reviews proposed modifications to approved APDs. An operator proposing modifications to significant aspects of an approved APD must submit an Application for Permit to Modify (APM)[5] to BSEE for review and approval. An operator must submit an APM for approval for any well abandonment, production enhancement (e.g., initiating artificial lift or replacing electrical submersible pumps), well workover (e.g., changing tubing or conducting casing pressure repairs), well completion (e.g., modifying perforations), or utility (e.g., changing a well to an injection well) activities.

The California District Office (CDO) Field Operations Section of BSEE's POCS Regional Office reviews all APDs and APMs. APD/APM District Production Engineering and Blowout Preventer (BOP) Control System Drawings are reviewed and documented in the eWell Permitting and Reporting System (eWell).[6] Concurrently, the Regional Office of Production and Development (OPD) reviews the APDs/APMs for conservation of oil and gas resources and for potential geohazards. The OPD performs a geologic review of proposed well drilling to confirm that drilling would not communicate with active faults or other wellbores. The APM undergoes environmental review (see Section 1.3), and BSEE only approves an APD/APM after determining that the permit

[5] Per 30 CFR 250.465, an APM (Form BSEE-0124) must be submitted when an operator intends to (1) revise the drilling plan, change major drilling equipment, or plugback; (2) determine a well's final surface location, water depth, and rotary kelly bushing elevation; or (3) move a drilling unit from a wellbore before completing a well. Plugback refers to the placement of cement or other material in a well to seal off a completion interval, to exclude bottom water, or to perform another operation such as sidetracking or producing from another depth. The term plugback also refers to the setting of a mechanical plug in the casing.

[6] BSEE's eWell is a comprehensive Internet permitting and reporting system for collecting information concerning well operations for each wellbore and well completion. It includes permits required for drilling and other well operations, as well as data collected for resource evaluation, waste prevention, conservation of natural resources, and protection of correlative rights, safety, and the environment. The eWell system has a built-in review function that allows BSEE to accept information submitted by operators in support of permit applications, or request additional or clarifying information. The eWell database is publically available at http://www.data.bsee.gov/homepg/data_center/plans/apdform/master.asp.

application complies with all applicable standards and regulations. The CDO then documents the decision to approve or deny the application in eWell.

1.3 HOW THIS DOCUMENT WILL BE USED

This draft PEA assists the Bureaus in complying with NEPA. This NEPA analysis will support BSEE as it individually processes oil and gas APDs and APMs for activities on the current active leases and operating platforms on the POCS, and decides whether to approve them. BOEM may also use this NEPA analysis in the event that the Bureaus need to make decisions on any supplemental or revised DPP required as a result of or related to the BSEE review of an APD or APM. In accordance with NEPA, BSEE and BOEM prepared this draft PEA to evaluate the potential environmental impacts of the Proposed Action and alternatives and to inform decisions on future requests to conduct well drilling, conductor installation, and a number of APM-requiring downhole activities on the POCS. BSEE and BOEM are joint lead agencies in the preparation of this draft PEA. In addition, this draft PEA will support the Department of the Interior (DOI) in meeting other environmental requirements (such as those of the Endangered Species Act, Marine Mammal Protection Act, and Coastal Zone Management Act) related to future POCS authorizations.

If the Bureaus determine that there are no significant impacts from the Proposed Action, a final PEA and associated Finding of No Significant Impact (FONSI) will be issued and no environmental impact statement (EIS) will be prepared. If a FONSI is issued, it will not constitute an immediate approval of potential future activities regulated by the Bureaus. Rather, the final PEA will provide the environmental analysis that will inform individual decisions on future permit applications and assist the Bureaus in complying with NEPA on those individual decisions.

BSEE will evaluate future APDs or APMs on a case-by-case basis to determine whether new information is available and whether there is a need for additional mitigations of potential environmental effects beyond the programmatic level analyzed in the final PEA. BSEE will conduct an environmental review each time a new APD or APM is received. BSEE will determine whether the proposed activity falls within the scope of this PEA (or some other completed relevant NEPA analyses), whether the environmental impacts have already been fully considered, and whether there are no significant new circumstances or new information relevant to environmental concerns and impacts not analyzed in this PEA. If any of these conditions are not met, BSEE will determine the type of additional NEPA analysis needed, which may require the preparation of a project-specific EA or EIS.

This draft PEA was prepared in accordance with the Council of Environmental Quality (CEQ) regulations (40 CFR Parts 1500–1508) and DOI implementing regulations (43 CFR Part 46) for NEPA. The draft PEA presents the purpose and need for the Proposed Action, describes the Proposed Action and reasonable alternatives to the Proposed Action, and identifies and evaluates the reasonably foreseeable environmental impacts of the Proposed Action and alternatives.

1.4 COMPLIANCE WITH OTHER ENVIRONMENTAL LAWS

As described above, the conclusion of this PEA will not represent an immediate and comprehensive approval of potential future regulated activities associated with well drilling and conductor installation. This document analyzes the potential effects of the Proposed Action to determine whether the effects may be significant, and whether or not an EIS may be warranted, consistent with DOI and CEQ regulations implementing NEPA. Endangered Species Act, National Historic Preservation Act, and other environmental consultation or compliance obligations are not triggered merely by the preparation of this programmatic analysis. Regardless of the outcome of this assessment, the Bureaus will continue to review every new application, take into consideration the unique characteristics of each proposal, determine whether existing consultations or compliance processes cover the proposal, engage in additional analyses and consultations deemed appropriate, and prepare a record of compliance with NEPA and all other applicable environmental laws prior to making a decision.

2 ALTERNATIVES, INCLUDING THE PROPOSED ACTION

2.1 INTRODUCTION

The Proposed Action and alternatives evaluated in this PEA address activities performed by oil and gas operators that require review, approval, and issuance of a permit by BSEE prior to initiation on the POCS. The project area for the Proposed Action and alternatives consists of the 38 currently active leases and surrounding areas (Figure 1-1). Under each of the alternatives, currently permitted oil and gas operations on the active leases would continue in accordance with existing plans, permits, and agency regulations. For the purposes of this PEA, the reasonably foreseeable future period during which any of the alternatives evaluated in this PEA may occur over a 5-year period (e.g., 2018–2023).[7] BOEM has developed a reasonably foreseeable estimate of the level of activity that could occur over such a time period, taking into account uncertainties in future oil and gas prices and other factors that drive oil and gas production on the POCS.

2.2 PROPOSED ACTION AND ALTERNATIVES

2.2.1 Alternatives Development

NEPA and the CEQ regulations mandate the consideration of "reasonable alternatives" for the proposed action. Reasonable action alternatives are those that could be implemented to meet the purpose and need of the proposed action. The alternatives (excluding No Action) evaluated in this PEA encompass various combinations of conductor installation and well drilling, which require an approved APD, and a variety of downhole operations requiring an APM (Table 2-1). Several additional alternatives were initially considered but dropped from further consideration (see Section 2.3).

The downhole operations that require an APM are associated with the types of work listed in BSEE OCS Operations Form 0124, *Application for Permit to Modify (APM)* (Figure 2-1). However, not all of these operations are included in the Proposed Action. Under the category "Abandonment of Well Bore," neither permanent abandonment nor site clearance (i.e., verification that a permanently abandoned well site is clear of obstructions) are addressed in this PEA, because these operations

[7] In response to the President's America-First Offshore Energy Strategy, Secretary of the Interior Zinke issued Secretarial Order 3350 in May 2017 to initiate the development of a new National Outer Continental Shelf Oil and Gas Leasing Program, with full consideration given to leasing offshore Alaska, Pacific, Mid-Atlantic, South Atlantic, and the Gulf of Mexico. BOEM released a Draft Proposed National Program at the end of 2017 that identified potential future lease sales on the POCS. Although no decision has yet been made on a 2019–2024 National Program, a new lease sale or sales could be proposed for the POCS during the new program period. Should there be a lease sale in the POCS, a new slate of subsequent development and production could change, perhaps substantially, the number of oil and gas production activities anticipated in this PEA. However, because the proposed program has not yet been finalized, and because any new activities under a new program would not take place until after several additional years of planning and analysis (including new NEPA analysis), any production activities arising from future lease sales in the POCS are not considered foreseeable at this time and will be appropriately addressed at a later date.

TABLE 2-1 Alternatives and Associated Permitted Platform Activities

Alternatives	Activities
Alternative 1—Proposed Action: Acceptance, Review and Authorization of Permit Applications for Conductor Installation, Drilling, Temporary Well Abandonment, and Downhole Operations	• APD-requiring conductor installation • APD-requiring new well drilling using current or new conductors • APD-requiring sidetracking[a] from existing wellbore • APM-requiring temporary well abandonment • APM-requiring enhanced production activities[b] • APM-requiring workover activities[c] • APM-requiring completion activities[d] • APM-requiring utility change in wells[e]
Alternative 2—Acceptance, Review and Authorization of Permit Applications for Conductor Installation, Drilling, Temporary Well Abandonment, and Downhole Operations, with Temporary Time Restrictions for Conductor Installation	• APD-requiring conductor installation, with seasonal closures during marine mammal migration • APD-requiring new well drilling using current or new conductors • APD-requiring sidetracking[a] from existing wellbore • APM-requiring temporary well abandonment • APM-requiring enhanced production activities[b] • APM-requiring workover activities[c] • APM-requiring completion activities[d] • APM-requiring utility change in wells[e]
Alternative 3—Acceptance, Review and Authorization of Permit Applications for Drilling, Temporary Well Abandonment, and Downhole Operations	• APD-requiring new wells drilling using only currently installed conductors • APD-requiring sidetracking[a] from existing wellbore • APM-requiring temporary well abandonment • APM-requiring enhanced production activities[b] • APM-requiring workover activities[c] • APM-requiring completion activities[d] • APM-requiring utility change in wells[e]
Alternative 4—Acceptance, Review and Authorization of Permit Applications Only for Downhole Operations Necessary for Safe Operations and Pollution Prevention	• APM-requiring temporary well abandonment • APM-requiring workover activities involving casing pressure repair[c]
Alternative 5—No Action: No Authorization of Permit Applications	• No approval of APDs or APMs

[a] Includes plugback to sidetrack or bypass.

[b] Includes artificial lift, jet well, and well washing and desanding.

[c] Includes change tubing and casing pressure repair.

[d] Includes initial completion of new wells, reperforation, perforation modification, and perforation zone changes.

[e] Includes changing well type to injection, and adding new fluids for injection in existing injection well.

1

Proposed or Completed Work		
16. PROPOSED OR COMPLETED WORK (Describe in Section 17)		
PLEASE SELECT ONLY ONE PRIMARY TYPE IN BOLD AND AS MANY SECONDARY TYPES AS NECESSARY		
☐ **Completion**	☐ **Workover**	☐ **Enhance Production**
☐ Initial Completion	☐ Change Tubing	☐ Acidize
☐ Reperforation	☐ Casing Pressure Repair	☐ Artificial Lift
☐ Change Zone		☐ Wash/Desand Well
☐ Modify Perforations	☐ **Abandonment of Well Bore**	☐ Jet Well
☐ **Utility**	☐ Permanent Abandonment	☐ Hydraulic Fracturing
☐ Initial Injection Well	☐ Temporary Abandonment	☐ **Information**
☐ Additional Fluids for Injection	☐ Plugback to Sidetrack/Bypass	☐ Surface Location Plat
☐ **Other Operations**	☐ Site Clearance	☐ Change Well Name
☐ Describe Operation(s)		

FIGURE 2-1 Block 16 of BSEE OCS Operations Form 0124, *Application for Permit to Modify (APM)*, which Identifies the Operation Work Types for which an APM is Required

are out of scope for this PEA. However, any APMs received for either of these operations will be reviewed by BSEE, and an appropriate level of NEPA assessment will be conducted on a case-by-case basis.

The "Enhance Production" operations (Figure 2-1) associated with acidizing and hydraulic fracturing were recently evaluated in the PEA for the use of well stimulation treatments (WSTs) on the POCS (BSEE and BOEM 2016), and thus are not addressed in this PEA. The "Information" category includes activities that are administrative, and thus not expected to result in any environmental disturbance.

The "Other Operations" category is for unique operations or those that do not readily fall into any of the other operation categories. Because activities in this category are undefined, it is not possible to speculate on the nature or number of APMs for Other Operations that BSEE may receive during the 5-year action period considered in this PEA. BSEE will review any such APMs and will conduct an appropriate level of NEPA assessment on a case-by-case basis.

2.2.2 Alternative 1—Proposed Action: Acceptance, Review, and Authorization of Permit Applications for Conductor Installation, Drilling, Temporary Well Abandonment, and Downhole Operations

Under the Proposed Action, BSEE would continue to accept and review APDs for conductor installation and well drilling, and APMs for temporary well abandonment and the following downhole work:

- Completion:
  - Initial completion of a new or sidetrack well,
  - Reperforation without increasing or decreasing an existing perforated zone,
  - Modifying perforations with the intent to increase or decrease the perforated zone,
  - Moving production zone from one location to another within a wellbore.

- Utility Work:
  - Converting from one existing well type to different type (e.g., production to injection),
  - Injecting fluids not previously injected in an existing injection well.

- Workover Operations:
  - Change out (replacement) of existing tubing in a well,
  - Repair of well casing for annular pressure remediation or unwanted communication.

- Enhance Production Operations:
  - Providing artificial lift using gas injection or downhole pumps,
  - Using jet or other pumps to start production during a well completion,
  - Performing well washing and desanding requiring wellhead removal.

Appendix B summarizes the activities that could be permitted under the Proposed Action.

Activities associated with the inspection, maintenance, and repair of pipelines, risers, and platform infrastructure that do not require a BSEE permit authorization but are required under BSEE regulations would continue to occur under each of the action alternatives, pursuant to compliance with the appropriate regulations. In the event that the work to be permitted under the Proposed Action by an APD or APM would require a revised or supplemental Development and Production Plan (DPP), BOEM's processing of the DPP may either be covered by this Programmatic EA or require site-specific NEPA analysis.

Projected Activity Levels under the Proposed Action. The Bureaus have identified a likely level of each activity that could be permitted under the Proposed Action in the reasonably foreseeable future. It is not possible to identify the specific number, timing, or locations where these activities could occur on the POCS in the foreseeable future; these would be determined by the platform operators and identified in their APD and APM submittals.

BSEE's eWell system was examined to identify how many APDs and APMs were approved for the POCS between 2012 and 2017 for the activities that could be permitted under the Proposed Action. This information was used to develop annual average numbers of permit approvals for the most recent and complete time period on record in the eWell system. The Bureaus also took into account the most recent forecasts for oil and gas production from the U.S. Energy Information Administration. Finally, the POCS platform operators provided information to BSEE regarding potential future conductor installation at the platforms for 2018–2023 (Salmons 2017). Considering this information, projected permit-requiring activity levels under the Proposed Action were developed for a 5-year period (e.g., 2018–2023) (Table 2-2).

TABLE 2-2 Projected Activities at POCS Platforms That Could Be Permitted under the Proposed Action over a 5-Year Period (e.g., 2018–2023)

Activity	Total Initiated	Assumptions
Conductor Installation	Up to 80; 2–16 at any one platform	No operator planned conductor installation at the Santa Maria Basin platforms, and no installation at the Santa Barbara Channel West platforms due to lack of available slots. New installation only at Platforms Hogan, Houchin, A, B, C, Gilda, Hillhouse, Ellen, and Edith. New conductors at other platforms most likely at platforms with at least five available slots and no available conductors.
Drilling	Up to 10 new wells; up to 33 sidetrack	New wells only in slots with conductors. Sidetracking at any production well. No new wells at Platforms Heritage, Hondo, or Henry due to lack of slot/conductor availability.
Vessel Operations	Up to 123	Vessels operations for delivery of conductors, drill pipe, drill muds, and other associated supplies. Assumes one vessel trip for each conductor and for each drilling activity.
Additional Helicopter Operations	Up to 123	Helicopter operations to deliver BSEE inspectors during conductor installation or drilling. Assume one operation equals one day of offshore flying.
Temporary Well Abandonment	Up to 32[a]	Assumes 5/yr based on 2012–2017 approved APMs. Years 1–2 include one well at Platform Grace and 22 wells at Platform Gail.
Production Enhancement, Artificial Lift	Up to 55[b]	Assumes 11/yr based on 2012–2017 approved APMs.
Production Enhancement, Jet Well	0–1[b]	Assumes <1/yr based on 2012–2017 approved APMs. A single APM was approved in 2017.
Production Enhancement, Wash/Desand Well	Up to 5[b]	Assumes 1/yr based on 2012–2017 approved APMs. A single APM was approved in 2017.
Utility Work, Initial Injection Well	Up to 10[b]	Assumes 2/yr based on 2012–2017 approved APMs.
Utility Work, Additional Injection Fluids	0–1[b]	Assumes <1/yr based on 2012–2017 APMs.
Workover Operations, Change Tubing	Up to 75[b]	Assumes 15/yr based on 2012–2017 approved APMs.
Workover Operations, Casing Pressure Repair	Up to 15[b]	Assumes 3/yr based on 2012–2017 approved APMs.
Completion, Initial Completion	Up to 20[b]	Assumes 4/yr based on 2012–2017 approved APMs. Also considers projected new well drilling and sidetracking.
Completion, Reperforation	Up to 20[b]	Assumes 4/yr based on 2012–2017 approved APMs.
Completion, Modify Perforations	Up to 20[b]	Assumes 4/yr based on 2012–2017 approved APMs.
Completion, Change Zone	Up to 5[b]	Assumes 1/yr based on 2012–2017 approved APMs.

[a] Projected activity levels based on a combination of the 23 wells to be shut down as Platforms Grace and Gail begin pre-decommissioning activities, a rate of 5 APM/year for temporary well abandonment based on eWell reported approved APMs from 2012–2017, and an additional 15% contingency (on the 2012–2017 rate) to capture possible increased permit applications in the event that oil prices decline, making production from some wells uneconomical.

[b] Projected activity levels based on number of APMs approved 2012–2017 as listed in eWell unless otherwise noted.

2.2.3 Alternative 2—Acceptance, Review, and Authorization of Permit Applications for Conductor Installation, Drilling, Temporary Well Abandonment, and Downhole Operations, with Temporary Time Restrictions for Conductor Installation

Under Alternative 2, BSEE would continue to accept and review APDs and APMs as under the Proposed Action. However, to minimize the potential for affecting marine mammals during conductor installation (i.e., by conductor installation noise and ship strikes by support vessel traffic), BSEE would not authorize conductor installation activities during certain times of the year (i.e., when there is the greatest likelihood of marine mammals being in the project area).

The occurrence patterns of marine mammals in the project area (Table 2-3) suggest two possible seasonal closure periods, each of which may reduce exposure of some species that may occur in the vicinity of the POCS platforms and leases. A summer closure period may reduce potential exposure to two whale (blue and fin) and three dolphin (bottlenose, short-beaked, and long-beaked) species. A winter closure may reduce potential exposure to two different whale species (humpback and Pacific grey) and three dolphin species (bottlenose, short-beaked, and Pacific white-sided).

2.2.4 Alternative 3—Acceptance, Review, and Authorization of Permit Applications for Drilling, Temporary Well Abandonment, and Downhole Operations

Under this alternative, BSEE would continue to accept and review APDs and APMs as under the Proposed Action, but would no longer accept APDs for new conductor installation, thus avoiding potential impacts from conductor installation. Under this alternative, the numbers of new and sidetrack wells and associated support vessel traffic and BSEE helicopter inspector flights would be similar to those under the Proposed Action. However, new well drilling requiring a conductor would be limited to only platforms with available conductors already in place (Appendix B).

2.2.5 Alternative 4—Acceptance, Review, and Authorization of Permit Applications Only for Downhole Operations Necessary for Safe Operations or Pollution Prevention

Under Alternative 4, BSEE would no longer accept or approve APDs for conductor installation or drilling, nor APMs for most downhole operations. BSEE would accept and review APMs for downhole operations deemed necessary to ensure safe operations or pollution prevention of currently permitted as well as routine activities (see Section 2.2.7). The operations that could be permitted under this alternative would be limited primarily to temporary well abandonment and casing pressure repair. Based on the number of APMs approved from 2012 to 2017, as many as 32 APMs for temporary well abandonment and 15 APMs for casing pressure repair may be expected over a 5-year period (Table 2-2).

2.2.6 Alternative 5—No Action: No Approval of Applications for Permits to Drill or Permits to Modify

Under the No Action Alternative, BSEE would no longer accept or approve APDs or APMs for any activities currently requiring permit authorization, including any APMs for activities related to safety or pollution prevention. The Bureaus employ this No Action alternative to comply with the NEPA regulations and provide a baseline against which to compare the potential effects of the

TABLE 2-3 Seasonal Likelihood of Occurrence of Selected Marine Mammals in the Vicinity of the POCS Platforms

Selected Marine Mammal Species	Relative Likelihood of Occurrence in the Vicinity of the POCS Platforms[e]				Notes
	Winter	Spring	Summer	Fall	
Blue Whale[a]			■		Very uncommon/absent in winter/spring. Diet determines abundance/distribution; feeding areas identified in vicinity of the Santa Maria Basin and San Pedro Bay leases. Most sightings occur in summer at water depths ≥2,000 ft. (610 m); occasional individuals sighted in summer in coastal and shelf areas in the eastern Santa Barbara Channel and the San Pedro Basin leases.
Fin Whale[a]			▒		May be found year-round in Southern California Bight in deep (≥2,000-ft. [610-m]) water; most often observed in summer in small numbers well offshore, away from POCS leases. Occasional individuals observed in the vicinity of the San Maria Basin leases.
Humpback Whale[b]	▒	▒			May be found year-round in Southern California Bight in deep (≥2,000-ft. [610-m]) water, most often observed in winter and spring well offshore (well west of the Channel Islands and Catalina Island) and away from POCS platforms and leases. Occasional individuals observed in the vicinity of the Santa Barbara Channel East platforms.
Pacific Grey Whale[c]	■	■			Northern spring migration from winter breeding grounds in Baja, Mexico, to Arctic feeding grounds passes through the areas of the POCS leases; southern winter migration to Baja passes through the area. Absent from the area in summer and fall.
Sperm Whale[a]					Present year-round, but in very deep waters (≥6,000 ft. [1,830 m]) well away from the POCS platforms and leases.
North Pacific Right Whale[a]					Extremely rare and not expected to occur in vicinity of the POCS platforms.
Sei Whale[a]					Very uncommon and not expected to occur in vicinity of the POCS platforms.
Bottlenose Dolphin[d]	▒	▒	▒	▒	Found year-round in coastal waters within 1 mi (1.6 km) of shore throughout Southern California; may occur in vicinity of the POCS platforms.
Short-beaked Common Dolphin[d]	▒		▒	▒	Relatively common in deep waters beyond the Channel Islands and Catalina Island in all seasons; observed in areas with water depths encompassed by the POCS platforms, including the Santa Barbara Channel.
Long-beaked Common Dolphin[d]			▒	▒	Relatively common in vicinity of Channel Islands; observed in the Santa Barbara Channel.
Pacific White-sided Dolphin[d]	▒	▒			Reported year-round in deeper waters beyond the Channel Islands and Catalina Island; observed in vicinity of Santa Maria Basin and Santa Barbara East platforms and leases.

TABLE 2-3 (Cont.)

Selected Marine Mammal Species	Relative Likelihood of Occurrence in the Vicinity of the POCS Platforms[e]				Notes
	Winter	Spring	Summer	Fall	
Risso's Dolphin[d]					Reported from deeper waters south and west of Catalina Island, well away from the San Pedro Bay platforms and leases.
Dall's Porpoise[d]					Occurs largely in deep waters (>5,000 ft. [1,520 m]) well away from the POCS platforms and leases.

[a] Listed as endangered under the Endangered Species Act (ESA), and as depleted under the Marine Mammals Protection Act (MMPA).

[b] Individuals from both ESA endangered and threatened Distinct Population Segments.

[c] Eastern North Pacific population delisted from ESA; protected under MMPA.

[d] Protected under MMPA.

[e] Dark grey = season most likely to occur in vicinity of platforms and leases; light grey = may occur in vicinity of platforms and leases; white = not observed, absent, or not likely to occur in vicinity of platforms and leases.

Sources: BOEM and BSEE (2017b); Douglas et al. (2014); Campbell et al. (2015); Calambokidis et al. (2015); Bearzi and Saylan (2011); NOAA Fisheries 2016 Marine Mammal Stock Assessment Reports.

action alternatives. However, BSEE notes that ongoing regulatory and statutory requirements would continue to apply, especially those for maintaining safe operations and protecting the environment on the OCS. Importantly, BSEE would enforce a shut-in of wells posing a serious or threatening violation of safety regulations by issuing an Incident of Noncompliance.

2.2.7 Routine Operations Common to All Alternatives

Under each of the alternatives, including No Action, routine activities associated with the inspection, maintenance, and repair of pipelines, risers, and platform infrastructure (e.g., decking painting or replacement, electric upgrades) would continue. These activities that do not require a BSEE permit authorization but are required under BSEE regulations at 30 CFR Part 250 would continue to occur, pursuant to compliance with the appropriate regulations (e.g., pipeline inspections compliant with 30 CFR 250.1005; riser inspections compliant with 30 CFR 250.739).

Supply vessel traffic and helicopter flights conveying platform workers and BSEE inspectors would continue to occur under each of the alternatives. Crew and supply ships average about 16 trips per week per platform on the POCS (BOEM and BSEE 2017a,b). Helicopter flights supporting operations on the POCS platforms average between 45,000 and 50,000 miles per year (BOEM and BSEE 2017a,b), while flights supporting BSEE inspectors averaged 317 per year between 2013 and 2016, with an average total annual fight duration of 371 flight hours per year.

2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER EVALUATION

The Bureaus considered but eliminated from further evaluation in this PEA four other potential alternatives. BSEE and BOEM determined these alternatives either encompassed activities that had previously undergone NEPA analysis and were approved for use on the POCS platforms, were not reasonably foreseeable, or are so uncertain that it is not possible to develop an activity description sufficient to allow for an adequate NEPA evaluation. Thus, BSEE and BOEM did not carry these alternatives forward for analysis in this PEA.

2.3.1 Acceptance, Review, and Authorization of Permit Applications for Conductor Installation and for Drilling, but No Use of Well Stimulation Treatments

The use of WSTs on the POCS recently underwent a NEPA evaluation (BSEE and BOEM 2016), and a finding of no significant impact (FONSI) was issued regarding WST use at the POCS production platforms.

2.3.2 Acceptance, Review, and Authorization of APDs for Conductor Installation and Drilling, but No Open Water Discharge of Produced Water or Drilling Wastes

The 2016 PEA on the use of WSTs on the POCS (BSEE and BOEM 2016) included an alternative that prohibited the open-water discharge of produced water or drilling wastes generated during the use of WSTs. That analysis determined that the open-water discharge of produced water and drilling wastes subject to a U.S. Environmental Protection Agency National Pollutant Discharge Elimination Permit (with or without WST-related constituents) posed no significant environmental effects.

2.3.3 Acceptance, Review, and Authorization of Permit Applications for New Pipeline Construction or Replacement

A review of inspection reports for pipelines on the POCS indicates that all current pipelines on the POCS have a 20-year predicted life expectancy or more, and thus the need for major replacement of any POCS pipelines is not expected in the foreseeable future (BSEE and BOEM 2017). The existing pipelines also meet current production and processing needs of oil and gas operations on the POCS. Because overall production on the POCS is expected to continue to decline, a need for new pipelines is not considered likely for the foreseeable future.

2.3.4 Acceptance, Review, and Authorization of Permit Applications for Major Platform Modifications

The type of modification that may occur will vary considerably among platforms, depending on platform-specific needs. Therefore, it is not possible to identify the nature, number, or magnitude of any major modifications that may occur on the POCS platforms in the foreseeable future. To date, there have been no permit applications for major platform modifications on any of the POCS platforms, and none are expected in the foreseeable future.

2.4 ENVIRONMENTAL RESOURCES CONSIDERED IN THIS ASSESSMENT

To determine which aspects of the environment could be affected with implementation of the activities that could be permitted under the Proposed Action, a review was conducted to identify the environmental resources and the socioeconomic and sociocultural (including environmental justice) conditions that are present in the vicinity of the platforms on the POCS. Sources of information for this review included previously prepared EAs for oil and gas-related activities at one or more of the active POCS platforms (BSEE and BOEM 2016; BOEM 2014a; BOEMRE 2011; MMS 2009), the open scientific literature, and agency reports. Based on this review, a number of resources and conditions were identified that may be affected by activities that could be permitted under the Proposed Action, and these are evaluated in this PEA.

2.4.1 Environmental Resources and Socioeconomic Conditions Potentially Affected by Activities Permitted Under the Proposed Action

The following resources and socioeconomic conditions are evaluated in this PEA for potential impacts from implementation of activities that could be permitted under the Proposed Action:

- *Air Quality:* Potential impacts from emissions from platform- and support-vessel-based internal combustion engines associated with well drilling, conductor installation, downhole operations, and helicopter and ship support traffic.

- *Water Quality:* Potential impacts from sediment resuspension during conductor installation, and open-water discharge of drilling wastes.

- *Marine Invertebrate Resources (including special status species[8]):* Potential impacts from sediment resuspension during conductor installation and from open-water discharge of drilling wastes.

- *Marine Fish (including special status species) and Essential Fish Habitat:* Potential impacts due to noise from conductor installation, and disturbance from sediment resuspension during conductor installation and from open-water discharge of drilling wastes.

- *Sea Turtles:* Potential impacts from noise during conductor installation, and from collisions with support vessels.

- *Marine Birds (including special status species):* Potential impacts from noise during conductor installation, and artificial lighting.

- *Marine Mammals (including special status species):* Potential impacts from noise during conductor installation, and from collisions with support vessels.

[8] Special status species are those species listed and protected under the ESA and/or the MMPA.

- *Commercial and Recreational Fisheries:* Potential impacts due to disturbance of fish by noise and sediment resuspension during conductor installation.

- *Socioeconomics*: None of the activities associated with the Proposed Action are expected to significantly affect employment, income, State and local tax revenues, population growth, housing, or community and social services. However, under Alternatives 4 and 5 (No Action), oil and gas production may decline more quickly than under any of the other alternatives, which could result in a more rapid decline in local employment, income, and state and local tax revenues.

A number of resources and socioeconomic conditions are not expected to be affected by the activities that could be permitted under the Proposed Action, and thus were not evaluated for activity-related impacts. These resources and conditions are as follows:

- *Geologic Resources/Seismicity:* None of the activities that could be permitted are expected to affect geologic resources on the POCS, and all APDs and APMs for drilling would undergo review to ensure that the proposed drilling operations will not communicate with active faults.

- *Archeological Resources:* No impacts on archeological resource are anticipated, because none of the activities that could be permitted will affect seafloor areas where such resources may occur. Bottom disturbance would only occur during conductor installation. This would be restricted to an area within the footprint of an existing platform, and such areas have previously been surveyed and cleared.

- *Recreation and Tourism:* Neither tourism nor recreation are expected to be affected, because all activities that could be permitted would occur well offshore and away from areas used for coastal recreation and tourism activities. Any permitted activities are also not expected to affect offshore recreational boating, whale watching, or deep-sea fishing, because support vessel traffic is not expected to result in visual or noise annoyance to tourists or recreationists, or in recreational space-use conflicts.

- *Marine Protected Areas, Parks, and Preserves:* Because of the distance from the active POCS platforms to any marine protected areas, activities that could be permitted under the Proposed Action are not expected to affect the purpose or use of such areas.

- *Military Training Areas:* A variety of military use areas (air space and water areas) and installations occur in coastal and offshore areas of Southern California, and some of the POCS platforms are located within or near these areas and installations. Use of military use areas would not be affected by any activities that could be permitted under the Proposed Action. This is also the case for coastal military installations. The POCS platforms are several nautical miles offshore from any coastal military installations, and thus permitted activities that could occur at the platforms would not affect the installations or interfere with their operations. Newly permitted activities would not affect either danger zones (water areas used for target practice, bombing, rocket firing, or other especially hazardous operations, normally for the armed forces) or restricted

areas (water areas designated for the purpose of prohibiting or limiting public access in order to provide security for government property and/or protection to the public from the risks of damage or injury arising from the government's use of that area).

- *Environmental Justice:* None of the activities that could be permitted under the Proposed Action are expected to result in any adverse effects on minority or low-income populations. All the permitted activities would use existing infrastructure and facilities, and would occur on already-operating platforms. Although some low-income and minority populations occur around Port Hueneme and the Port of Los Angeles, from which staging of supplies (e.g., conductors) and personnel could occur, none of the permitted activities are expected to increase activities at these ports to levels that could disproportionately affect low-income or minority populations.

3 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

The Proposed Action would apply to oil and gas operations and activities within 38 active leases in Federal waters of the Pacific Outer Continental Shelf (POCS). For this Programmatic Environmental Assessment (PEA), the 38 leases where the permitted activities may be carried out represent the project area for the Proposed Action (Figure 1-1). The affected environment described within this chapter includes the project area, and those additional areas outside of the project area where the direct or indirect effects of the proposed action may occur.

3.2 AIR QUALITY

3.2.1 Ambient Air Quality Standards

Under the Clean Air Act (CAA), the U.S. Environmental Protection Agency (EPA) has established the National Ambient Air Quality Standards (NAAQS) for six principal pollutants (known as "criteria" pollutants) (40 CFR 50). These pollutants are ozone (O_3), particulate matter (PM) with aerodynamic diameters of 10 microns (μm) or less and 2.5 μm or less (PM_{10} and $PM_{2.5}$, respectively), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead (Pb) (EPA 2017a). Collectively, the levels of these criteria pollutants are indicators of the overall quality of the ambient air. The California Air Resources Board (ARB) has established separate standards, the California Ambient Air Quality Standards (CAAQS) (ARB 2017a), for the same NAAQS six criteria pollutants. In general, the CAAQS are more stringent than the NAAQS, except for the 1-hr NO_2 and SO_2 standards established in 2010.

3.2.2 Area Designations

The EPA and ARB each designate whether areas are in attainment[9] with the NAAQS and CAAQS, respectively. The four counties that border the Southern California OCS (Santa Barbara, Ventura, Los Angeles, and Orange counties) are all in attainment with NAAQS and CAAQS for CO, NO_2, and SO_2, while one or more of the counties are in nonattainment for one or more of the other criteria pollutants (Table 3-1).

3.2.3 Air Emissions

The estimated average annual emissions of criteria pollutants and reactive organic gases (ROG), which play a major role in the generation of photochemical oxidants in the atmosphere, in each of the four coastal counties along the project area are presented in Table 3-2 (ARB 2017c). Los Angeles County accounts for about two-thirds of the total annual emissions of all criteria pollutants and ROG; Orange County is the second-highest contributor to regional emissions; and Santa Barbara and Ventura counties are the smallest contributors.

[9] An area may be in attainment for one criteria pollutant but in nonattainment for the others. Areas may also be designated as unclassified; that is, there is insufficient information to determine attainment.

TABLE 3-1 Summary of State and Federal Attainment Designation Status[a] for Criteria Pollutants in Santa Barbara, Ventura, Los Angeles, and Orange Counties

	O_3		PM_{10}		$PM_{2.5}$		CO		NO_2		SO_2		Pb	
County	State	Fed.	State	Fed.	State	Fed.	State	Fed.	State	Fed.	State	Fed.	State	Fed.
Santa Barbara	N	A/U	N	U	U	A/U	A	A/U	A	A/U	A	U	A	A/U
Ventura	N	N	N	U	A	A/U	A	A/U	A	A/U	A	A	A	A/U
Los Angeles	N	N	N	A/U	NP	NP	A	A/U	A	A/U	A	A/U	A	NP
Orange	N	N	N	A	N	N	A	A/U	A	A/U	A	A	A	A/U

[a] A = attainment; N = nonattainment; NP = nonattainment in part of the county; and U = unclassified. Nonattainment is highlighted in gray.

Sources: ARB (2017b); EPA (2017b).

TABLE 3-2 2012 Estimated Average Annual Emissions (tons per day) of Criteria Pollutants and Reactive Organic Gases by County and by Source Category

Emission Source	ROG	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$
County						
Santa Barbara	31.24	99.09	72.55	12.18	14.53	5.49
Ventura	35.77	130.17	41.27	1.90	16.42	5.81
Los Angeles	293.02	1,339.74	348.82	15.84	98.03	43.86
Orange	92.70	413.84	81.47	1.51	23.00	10.52
Four-county total	452.73	1,982.84	544.11	31.43	151.98	65.68
Source Category						
Fuel Combustion	11.15	54.94	47.92	6.97	6.74	5.87
Waste Disposal	9.01	1.24	2.08	0.56	0.32	0.22
Cleaning & Surface Coatings	39.09	0.05	0.09	0.01	1.34	1.29
Petroleum Production & Marketing	34.20	5.66	1.44	2.41	1.76	1.53
Industrial Processes	8.86	0.83	0.62	0.62	16.57	6.51
Solvent Evaporation	102.41	0.00	0.00	0.00	0.01	0.01
Miscellaneous Processes	12.70	66.63	19.70	0.52	90.30	27.98
On-road Motor Vehicles	142.02	1,193.61	265.71	1.72	23.61	12.14
Other Mobile Sources	93.29	659.88	206.55	18.62	11.33	10.13
Four-county total	452.73	1,982.84	544.11	31.43	151.98	65.68

Source: ARB (2017c).

Natural emission sources in the project area include biogenic emissions from plants and trees, geogenic emissions from marine seeps on the continental shelf, wildfires, and windblown dust. In Santa Barbara and Ventura counties, natural emissions are comparable to or higher than man-made emissions for ROG or PM (ARB 2017c). Geogenic emissions in this region are largely limited to Santa Barbara and Ventura counties, where they are as much as 60% and 11%, respectively, of average annual man-made ROG emissions totals for these counties.

In general, greenhouse gas (GHG) emissions data are not available at the county level. In California, the total Statewide gross[10] GHG emissions in 2012 (the most recent year for which information is available) were estimated to be about 442 million metric tons (MMT) carbon dioxide equivalent (CO_2e)[11] (ARB 2017d), which would be about 6.6% of the total GHG emissions for the United States (EPA 2017c). About 84% of the California total GHG emissions are carbon dioxide (CO_2), followed by methane (CH_4, 9.0%), high-global-warming potential GHGs[12] (3.9%), and nitrous oxide (N_2O, 2.8%). Transportation (about 37%) is the single largest source of GHG emissions in California, followed by industrial sources (24%) and electricity production (20%).

3.2.4 Regulatory Controls on OCS Activities Affecting Air Quality

The EPA has promulgated requirements (40 CFR Part 55) to control air pollution from POCS sources. However, it has delegated its oversight of offshore facilities (including the POCS platforms) to the local air districts that regulate the facilities. These local air districts regulate emissions from offshore platforms with Permits to Operate that define permitted emissions from specified platform-based equipment (e.g., diesel engines) and service vessels.

3.3 ACOUSTIC ENVIRONMENT

Along the U.S. west coast, long-term monitoring data suggest an average increase of about 3 decibels (dB) per decade in low-frequency ambient noise as shipping in the region has increased (Andrew et al. 2002; McDonald et al. 2006, 2008). Ambient noise levels at a given frequency and location may vary widely on a daily basis, and a wider range of ambient noise levels occurs in shallow water (depths less than 656 ft. [200 m]) than in deeper water. Ambient noise sources (especially noise from wave and tidal action) can cause particularly high ambient noise levels in coastal environments.

Natural sources of ambient noise in the POCS are wind and wave activity, including surf noise near the beaches; noise from rain and hail; lightning noise; and biological noise from marine mammals, fishes, and crustaceans (Greene 1995; URI 2017). Anthropogenic noise sources in the project area include transportation, dredging and construction, oil and gas operations, geophysical surveys, and sonar. Noise levels from most human activities are greatest at relatively low frequencies (<500 Hertz [Hz]). Offshore oil and gas activities produce a variety of underwater and airborne noises, and these are generally below 1,000 Hz (Greene and Moore 1995). Onshore coastal construction activities may also propagate into coastal waters (Greene and Moore 1995).

---

[10] Excluding GHG emissions removed due to forestry and other land uses.

[11] A measure to compare the emissions from various GHGs on the basis of the global warming potential (GWP), defined as the ratio of heat trapped by one unit mass of the GHG to that of one unit mass of CO_2 over a specific time period. For example, GWP is 25 for CH_4, 298 for N_2O, and 22,800 for sulfur hexafluoride (SF_6). Accordingly, CO_{2e} emissions are estimated by multiplying the mass of a gas by the GWP.

[12] These are the fluorinated GHGs, including SF_6, nitrogen trifluoride (NF_3), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs).

Transportation-related noise sources include aircraft (both helicopters and fixed-wing aircraft), commercial and recreational boating, and commercial ship traffic (e.g., supply ships serving the POCS platforms, large container vessels, and supertankers). In shallow water, shipping traffic more than 6 mi (10 kilometers [km]) away from a receiver generally contributes only to background noise. However, in deep water, low-frequency components of ship traffic noise may be detectable up to 2,485 mi (4,000 km) away and may contribute to background noise levels (Greene 1995).

3.4 WATER QUALITY

3.4.1 Regulatory Framework

Section 402 of the Clean Water Act (CWA) authorizes the EPA to issue National Pollutant Discharge Elimination System (NPDES) permits to regulate the discharges of pollutants to waters of the United States, the territorial sea, contiguous zone, and ocean. Since the introduction of the NPDES program, the Southern California Bight (SCB), in which the project area is located, has seen great reductions in pollutants from all sources, including 50% reductions in suspended solids, 90% in combined trace metals, and more than 99% in chlorinated hydrocarbons. These decreases have occurred despite great increases in population and in volumes of discharged wastewater (MMS 2001). Source control, pretreatment of industrial wastes, and treatment plant upgrades have combined to accomplish these reductions (MMS 2001; Lyon and Stein 2009).

Discharges from the POCS platforms are regulated under NPDES General Permit No. CAG 280000 (effective March 1, 2014, through February 28, 2019) (EPA 2013a).The NPDES General Permit regulates 22 types of platform discharges, and sets forth effluent limitations and monitoring and reporting requirements, including pollutant monitoring and toxicity testing of effluents. The point of compliance for effluents is the edge of the mixing zone, which extends laterally 328 ft. (100 m) in all directions from the discharge point and vertically from the ocean surface to the seabed. The NPDES General Permit does not apply to discharges from vessels supporting platform operations, which are regulated by the U.S. Coast Guard.

3.4.2 Regional Water Quality

Water quality in the SCB is generally good, particularly in the Santa Maria Basin area and points north because of low population and lack of major industry in adjacent coastal areas. In contrast, the Santa Barbara Channel region, which extends from Point Conception to Point Fermin and includes 12 of the 19 producing POCS oil platforms, has larger influxes of pollutants from coastal municipal sewage treatment discharges, power plant cooling water discharges, and industrial waste sources than points further to the north. Recent water quality surveys have found that at a bight-wide scale, natural nutrient sources make a larger contribution of nutrients than anthropogenic sources, but at smaller spatial scales, anthropogenic and natural nitrogen sources were comparable within orders of magnitude in some locations (Howard et al. 2012, 2014).

Major sources of pollutants to the project area include agricultural runoff, publicly owned treatment work (POTW) and chlorinated power plant cooling water outfalls, and atmospheric fallout from metropolitan areas (MMS 2001, 2005; Kaplan et al. 2010; Lyon and Stein 2010). Among these, POTWs represent the largest point source contributors to the SCB. Other important regional inputs include chemicals from harbors, dumping activities, dredging, vessel traffic, military activities, and industrial activities such as oil production (Kaplan et al. 2010). Untreated stormwater runoff from the SCB watershed represents a large non-point source of suspended solids, pollutants, and nutrient loads to the SCB. Noble et al. (2003) found that 96% of the shoreline met water quality standards during dry weather, but 58% of the shoreline failed water quality standards during wet weather, typically from late fall to early spring. Stormwater is an episodic input to the SCB, producing visible turbidity plumes, while POTWs produce continuous inputs.

Offshore oil and gas operations are relatively smaller contributors of pollution but contribute relatively higher amounts of hydrocarbon pollutants than the other anthropogenic sources mentioned (Lyon and Stein 2010). The largest contributors of hydrocarbons to offshore waters are the naturally occurring seeps within the Santa Barbara Channel. These seeps often produce localized, visible sheens on the water and lead to the production of tar balls commonly found on beaches after weathering and oxidation of oil (Hostettler et al. 2004; Farwell et al. 2009). Approximately 50 oil seeps occur off the shore of Southern California between Point Arguello and Huntington Beach. At least 38 of these seeps are located in the Santa Barbara Channel and release an estimated 40–670 bbl of crude per day to the channel, with the greatest releases near the Coal Oil Point Seep (MMS 2005). This seep field off the shore of Goleta, California, is approximately 6.9 mi^2 (18 km^2) and emits an estimated 50–170 bbl of oil and 100–130 tons of natural gas per day (Hornafius et al. 1999). Farwell et al. (2009) has described an associated 55-mi^2 (90-km^2) plume on the near-west seafloor estimated to contain 3.1×10^4 metric tons of petroleum in the top 1.9 in. (5 cm) of sediments.

3.4.3 Discharges from Offshore Oil and Gas Activities

Offshore discharges from past and present oil and gas operations in State and Federal waters include cooling water, produced water, sanitary waste, fire control system test water, well completion fluids, and miscellaneous other liquids. Of these, produced water represents by far the greatest discharge of petroleum-related chemical constituents. Well completion and treatment fluids represent the second-largest (but relatively minor) source of chemical discharges to POCS waters.

Offshore facilities may discharge treated produced water to the ocean per the NPDES General Permit or may inject it into an offshore subsurface reservoir. Producing platforms that do not discharge produced water transfer the water either to other platforms or to an onshore facility for treatment and disposal. The onshore facilities may dispose of the produced water through injection to a subsurface reservoir, or may transfer the treated water back to an offshore platform for disposal via injection or permitted discharge to the ocean. All permitted ocean discharges must meet the permit discharge limits and are tracked through quarterly Discharge Monitoring Reports required by the NPDES permits (Kaplan et al. 2010). All discharges in compliance with the NPDES General Permit contribute negligible degradation to water quality of the project area.

All platforms that discharge produced water under the NPDES General Permit do so either directly or via another platform (Houseworth and Stringfellow 2015). Platforms Irene, Ellen, and Eureka primarily reinject produced water into producing formations. Platform Elly, a processing-only platform, sends the produced water it receives from other platforms to platforms Ellen and Eureka for subsequent reinjection. Other NPDES-permitted platform discharges are associated with well treatment, workover, and completion fluids (Kaplan et al. 2010). These chemicals fall into three categories:

- Production-treating chemicals: scale inhibitors, corrosion inhibitors, biocides, emulsion breakers, and water-treating chemicals, including reverse emulsion breakers, coagulants, and flocculants;

- Gas-processing chemicals: hydrate inhibitors, dehydration chemicals, and occasionally H_2S removal chemicals; and

- Stimulation and workover chemicals: mineral acids, dense brines, and other additives.

Detailed descriptions of the amounts and compositions of the various permitted discharges (e.g., produced water, drilling wastes, operational fluids) that may occur at the POCS platforms can be found in BSEE and BOEM (2016).

3.5 MARINE AND COASTAL INVERTEBRATES

The POCS platforms in the Santa Maria Basin are located within the cold-temperate waters of the Oregonian Province, while the platforms within the Santa Barbara Channel and San Pedro Bay fall within the warm-temperate waters of the San Diego Province (NMFS 2015z). The physical and water quality conditions of the two provinces and the transition zone between them have resulted in the development of variety of distinctive subtidal benthic habitats and communities in the project area (Seapy and Littler 1978; Blanchette and Gaines 2007). The subtidal zone is the permanently submerged area below the low tide line. Because of the water depths at which the POCS platforms occur (95–1,200 ft. [29–366 m]), only subtidal habitats in deeper waters have a potential to be affected under the Proposed Action. Benthic community composition within these habitats is strongly determined by bottom type, which can be hard bottom (e.g., rock, cobble, boulder) or soft sediment (sand, mud, or a mixture).

A variety of corals and anemones, starfish and sea urchins, sponges, worms, and crustaceans dominate the benthic communities in hard-bottom habitats (Blake and Lissner 1993; Diener and Lissner 1995). The POCS platforms and pipelines also provide hard surfaces for hard-bottom communities in the project area, and surveys of some platforms and pipelines in the project area have found diverse hard-bottom communities growing on these structures (CSA 2005; Love and York 2005). Soft-bottom subtidal habitats in the project area also support diverse invertebrate communities, dominated by a variety of amphipod crustaceans, polychaetes, echinoderms, and molluscs (MMS 2001 citing SAIC 1986; Hyland et al. 1990; Blake and Lissner 1993; Bergen et al. 2001; Allen et al. 2011; Ranasinghe et al. 2012; Gillette et al. 2017).

The benthic habitats and communities of the SCB appear to be generally healthy, with less than 2% classified as moderate to highly disturbed (these are mostly in estuarine and marina areas) (Schiff et al. 2016; Gillette et al. 2017). More detailed discussions of the benthic resources in the project area can be found in BSEE and BOEM (2016).

Special-Status Invertebrate Species. The black abalone (*Haliotis cracherodii*) and the white abalone (*H. sorenseni*) are listed as endangered (74 FR 1937 and 66 FR 29054, respectively) under the ESA. Critical habitat has been designated under the ESA only for the black abalone in a variety of rocky subtidal and intertidal areas in the project area, including the shorelines of the Channel Islands and the coastline south of Point Conception (76 FR 66841). The range of the white abalone extends along the Pacific Coast from Point Conception south to Punta Abreojos, Baja California, Mexico.

The black abalone populations along the California coast south of Monterey County, California, have been estimated to have declined by as much as 95% (Neuman et al. 2010), while there has been a 99% reduction in white abalone abundance since the 1970s (Smith et al. 2003). Regulatory measures the State of California has taken during the past 30 years, including the closure of the white abalone fishery in 1996 and the closure of all abalone fisheries in Central and Southern California waters in 1997, have proven inadequate for recovery (NMFS 2008a). Historical and/or ongoing threats to both species include commercial overfishing, habitat destruction, and, more recently in the case of the black abalone, withering syndrome disease. Additional life history information, including recovery efforts, for these species can be obtained from the U.S. Fish and Wildlife Service (USFWS) Endangered Species Program (www.fws.gov/endangered).

3.6 MARINE AND COASTAL FISH AND ESSENTIAL FISH HABITAT

The following sections provide summary overviews of the marine and coastal fishes and essential fish habitat (EFH) in the project area. More detailed discussions of these resources appear in BSEE and BOEM (2016).

3.6.1 Marine and Coastal Fish

The POCS supports a diverse fish community reflective of the diverse habitats and the presence of cold and warm water masses divided by Point Conception (Dailey et al. 1993). Of the 554 species of California marine fishes, more than 480 species may occur in the SCB (Horn 1974 cited in MMS 2001). The life history varies greatly differ among species in terms of seasonal movements and occurrence; spawning location, season, and frequency; and depth and habitat distribution. Broadly, fish species found in the POCS can be characterized as diadromous, pelagic, soft-bottom demersal, or reef-associated, based on habitat associations and life history traits.

Diadromous fish, such as salmon, are species that move from oceanic feeding grounds to inland freshwater streams for spawning. The predominant diadromous species found in Southern California waters is the federally endangered steelhead salmon (*Oncorhynchus mykiss*), which is further discussed in Section 3.6.3.

Pelagic species occur at various depths throughout the water column and occupy a number of trophic levels. Pelagic species common in Southern California waters include plankton-feeding northern anchovy, Pacific sardine, Pacific herring, and Pacific mackerel, and larger predatory fish such as tuna, swordfish, and sharks. Some species are migratory and may be present in the POCS only in certain seasons. Commercial and recreational fisheries harvested in the project area include many pelagic fish species (Section 3.10).

Soft-bottom demersal fish are bottom-dwelling species associated with sand and mud-bottom habitats. More than 150 species of fish have been identified from such habitats in Southern California waters (Allen et al. 2011); some of the more abundant and widespread are various species of soles and sanddab (Allen et al. 2011; Miller and Schiff 2012). Other common soft-bottom demersal species include croaker, surfperch, turbot, rockfish, sculpin, and Pacific hake (Miller and Schiff 2012).

Reef fish are structure-oriented species inhabiting hard-bottom habitats and their associated sessile communities (e.g., mussel and kelp beds). More than 75 reef fish species have been reported in the SCB, including common species such as kelp bass, California sheephead, garibaldi, and black perch (Pondella et al. 2012). Reef fish also congregate around the POCS platforms and associated pipelines, which provide highly productive fish habitats (Claisse et al. 2014). Rockfish and lingcod are frequently observed species near platforms, while rockfishes, sanddabs, and comb fishes are typically found along pipelines (Love and York 2005).

3.6.2 Essential Fish Habitat and Managed Species

EFH pertains to habitat "required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem," and is defined as the water and substrate necessary for fish spawning, breeding, feeding, and growth to maturity (50 CFR Part 600). The Magnuson-Stevens Fishery Conservation and Management Act (MSA; 16 U.S.C. 1801 et seq.) as amended by the Sustainable Fisheries Act on October 11, 1996, requires regional fishery management councils, with assistance from the National Marine Fisheries Service (NMFS), to delineate EFH and habitat areas of particular concern (HAPCs) in Fishery Management Plans (FMPs) for all Federally managed fisheries. The Pacific Fishery Management Council (PFMC) has designated species-specific EFHs for four fishery management groups in the Pacific region, and FMPs have been developed for each group:

- Pacific coast groundfish, 87 species;
- Coastal pelagic species, 9 species;
- Highly migratory species, 13 species; and
- Pacific coast salmon, 3 species.

The EFHs for these species cover all waters and substrate with depths less than or equal to 2 mi (3,500 m), the upriver extent of saltwater intrusion in coastal rivers, and seamounts in depths greater than 2 mi (3.5 km). It is not uncommon for EFHs to overlap within and across the four fishery management groups. All the POCS leases and platforms are located within multiple designated EFHs.

The FMPs for two of the four management groups identify a number of HAPCs (PFMC 2016a). No HAPCs have been designated for coastal pelagic or highly migratory species (PFMC 2016b). The Pacific Coast Salmon FMP designates five HAPCs for the salmonids (PFMC 2016c). Estuaries and submerged aquatic vegetation are the primary HAPCs in the project area. The Pacific Coast Groundfish FMP identifies a number of HAPCs for groundfish, including estuaries, canopy kelp, seagrass, rocky reefs, and "areas of interest," which in the project area include the Cowcod Conservation Areas and the Channel Islands National Marine Sanctuary.

3.6.3 Special-Status Fish Species

Several species of marine and coastal fish in Southern California waters have been Federally listed as threatened or endangered under the ESA. These species are the green sturgeon (*Acipenser medirostris*), the steelhead (*Oncorhynchus mykiss*), the scalloped hammerhead shark (*Sphyrna lewini*), and the tidewater goby (*Eucyclogobius newberryi*). Information regarding life histories, distribution, status, and recovery efforts for these species can be obtained from the USFWS Endangered Species Program (www.fws.gov/endangered). Of these, only the steelhead may possibly occur near the POCS platforms and be potentially affected by the proposed activities.

Steelhead. The NMFS has identified 10 distinct evolutionarily significant units (ESUs)[13] of steelhead, two of which are listed as endangered and eight of which are listed as threatened (50 CFR 223 and 224). Only the Southern California steelhead ESU (endangered) may occur in the project area. The range of this ESU extends from the Santa Maria River basin to the U.S.–Mexico border. The Santa Ynez, Ventura, and Santa Clara Rivers, as well as the Matilija Creek, have had significant historical steelhead runs (Good et al. 2005). The distribution and life history of the steelhead are described in NMFS (2012).

3.7 SEA TURTLES

Five species of sea turtle occur in the POCS offshore of Southern California. Three species are Federally endangered: the hawksbill sea turtle (*Eretmochelys imbricata bissa*), leatherback sea turtle (*Dermochelys coriacea*), and loggerhead sea turtle (North Pacific Ocean Distinct Population Segment [DPS]) (*Caretta caretta*); and two species are Federally threatened: the green sea turtle (*Chelonia mydas*) (East Pacific DPS) and olive ridley sea turtle (*Lepidochelys olivacea*). No known nesting habitat for any of the five species occurs in the project area. Threats to sea turtles throughout their ranges include incidental capture, entanglement, and injury/death from fishing gear; marine debris; environmental contamination; disease, loss, or degradation of nesting habitat; beach armoring; artificial lighting; non-native vegetation; and directed harvest (NMFS 2014c). Additional life history information, including recovery efforts, for these species is available from the National Oceanic and Atmospheric Administration (NOAA) Fisheries, Protected Species Program (http://www.nmfs.noaa.gov/pr/species/turtles).

[13] An ESU is a population of organisms considered distinct for conservation purposes. To be considered an ESU, the population must be reproductively isolated from other populations of the same species and must represent an important component of the evolutionary legacy of the species (61 FR 4722).

Green Sea Turtle. Although the green sea turtle is uncommon along the California coast, it may be present year-round off Southern California, with highest numbers observed in July through September (BSEE 2011). It is usually seen in El Niño years when ocean temperatures are warmer than normal. A few green sea turtles are regularly seen in Orange County near the San Gabriel River (California Herps 2017). Similarly, a Long Beach power plant warms the waters of the San Gabriel River (Sahagun 2008), where a small colony of green sea turtles now resides (California Herps 2017). This colony is inshore from the San Pedro Bay Platforms.

Hawksbill Sea Turtle. The hawksbill sea turtle is only occasionally observed in waters from Point Conception to the U.S.–Mexico border and usually during El Niño years (California Herps 2017). It therefore may occasionally be present near the POCS platforms. This species is most commonly associated with healthy coral reefs but also inhabits coastal waters in rocky areas, mangrove-bordered bays, estuaries, mud-bottomed lagoons, and, occasionally, deep water (NMFS 2014d; California Herps 2017).

Leatherback Sea Turtle. The leatherback sea turtle may be most common sea turtle in U.S. waters north of Mexico but is rarely seen (PXP 2012). This species may be sighted from Port Arguello southward through the Santa Barbara Channel (California Herps 2017), but is absent from the area in winter. Critical habitat has been designated in the coastal area from Point Arguello northward and inshore of the 3,000-m depth contour (NMFS 2012), which is near Platform Irene in the San Maria Basin.

Loggerhead Sea Turtle. The loggerhead sea turtles found in Southern California waters are presumed to be members of the North Pacific Ocean DPS (NMFS and USFWS 2011). Most sightings off the California coast are of juveniles and tend to occur from July to September, although in El Niño years observations can occur over most of the year. This species is primarily pelagic but occasionally enters coastal bays, lagoons, salt marshes, estuaries, creeks, and mouths of large rivers, and in the project area has been observed at scattered locations from Point Conception southward to the U.S.–Mexico border (California Herps 2017).

Olive Ridley Sea Turtle. The olive ridley sea turtle is the most abundant sea turtle in the world, with an estimated 800,000 females nesting annually (NMFS 2014d). This species is highly migratory and spends much of its non-breeding life cycle in the oceanic zone (NMFS and USFWS 2014d), but is known to inhabit coastal areas (e.g., bays, estuaries) (NMFS 2014d). This species rarely occurs along the California coast but has been reported off Point Conception (California Herps 2017).

3.8 MARINE AND COASTAL BIRDS

A diverse assemblage of birds occurs within Southern California. Some species breed in the area and others occur only as non-breeding summer residents, winter residents, or migrants. The Channel Islands are especially important areas, providing essential nesting and feeding grounds for 99% of seabirds in Southern California, and important wintering areas and stopover points for shorebirds (Kaplan et al. 2010; NPS 2017). More than 385 species have been recorded in the immediate vicinity of the northern Channel Islands (Collins 2011). NMSP (2008), Collins (2011),

SAIC (2011), and PXP (2012) list the coastal and marine bird species and their occurrence. Additional information can be found in BSEE and BOEM (2016), as well as in the cited references.

3.8.1 Seabirds

More than 50 seabird species have been documented between Cambria, California, and the Mexican border, an area that includes the POCS platforms (Mason et al. 2007). Common nearshore seabird species (e.g., loons, grebes, gulls, terns) (Mason et al. 2007) in general are unlikely to occur with any regularity near the POCS platforms. More likely to occur near platforms are the pelagic seabirds (e.g., shearwaters, storm-petrels, cormorants, phalarope, albatross, and the California brown pelican [*Pelecanus occidentalis*]), which generally occur over deeper waters (Mason et al. 2007). Although they are generally present throughout the year, their abundance varies seasonally.

Twenty seabird species are known to breed in Southern California, almost entirely on the Channel Islands. These include the California brown pelican, Scripps's murrelet (*Synthliboramphus scrippsi*), Cassin's auklet (*Ptychoramphus aleuticus*), and double-crested cormorant (*Phalacrocorax auritus*) (Mason et al. 2007; NPS 2017). Other areas of elevated seabird abundance within the project area include Point Conception, the Santa Monica Basin, Anacapa Island, Bolsa Bay, and Palos Verdes/Bolsa Chica (Sydeman et al. 2012). For many seabirds, the region off Point Conception is a particularly important foraging area (SAIC 2011).

Some seabird species (e.g., California brown pelican, cormorants, gulls) habitually use the substructure of POCS platforms for nighttime roosting (Johnson et al. 2011). This association is due more to the availability of appropriate structures for roosting than to the lighting on the platforms (Johnson et al. 2011).

3.8.2 Shorebirds

While more than 40 shorebird (e.g., plovers, sandpipers) species have been recorded from Southern California, fewer than 25 species occur regularly in the project area. Few shorebirds (e.g., black oystercatcher [*Haematopus bachmani*]) breed in the area (Arata and Pitkin 2009; Rodriguez et al. 2011), with most species migrating to the area in the fall to overwinter and leaving in spring for northern breeding grounds. The Channel Islands are a particular important wintering and migratory stopover area (NPS 2017). Areas adjacent to the Southern California POCS and commonly used by shorebirds include Mugu Lagoon, the Santa Clara River mouth, Carpinteria Marsh, Goleta Slough, and the Santa Ynez River mouth (MMS 2001).

3.8.3 Waterfowl and Wading Birds

Waterfowl and wading birds inhabit coastal freshwater, brackish, and saltwater wetlands, such as Carpinteria Marsh and Mugu Lagoon and various river and stream mouths. About 25 species of wading birds (e.g., herons, egrets, rails, and coot) have been reported from the coastal regions of Southern California. About 40 waterfowl species (geese, ducks, and mergansers) also occur in the coastal areas of Southern California.

3.8.4 Special-Status Bird Species

Eighteen special-status species, including four Federally listed species, have been reported from the Southern California POCS and may occur in the project area. Species accounts for the Federally listed species can be obtained from the USFWS Endangered Species Program (www.fws.gov/endangered), while species accounts for California-listed species can be obtained from the California Department of Fish and Wildlife Bird Species of Special Concern Program (www.wildlife.ca.gov/Conservation/SSC/Birds). The following paragraphs present short summaries of the presence of each of the Federally listed threatened or endangered species.

Light-footed Ridgway's Rail (*Rallus obsoletus levipes*). This Federally endangered species inhabits coastal salt marshes from Santa Barbara County south to Baja California (Zembal et al. 1989, 1998; Zembal and Hoffman 1999). No critical habitat has been designated for this species. Marshes in the vicinity of the project area where nesting pairs have been documented include Mugu Lagoon in Ventura County and Seal Beach, Bolsa Chica, Huntington Beach Wetlands, and Upper Newport Bay in Orange County (Zembal et al. 2016).

Western Snowy Plover (*Charadrius n. nivosus*). The Pacific Coast DPS of the western snowy plover is Federally listed as threatened. Its critical habitat is associated with coastal beach-dune ecosystems along the Pacific Coast, and 23 critical habitat units have been designated along the project area. These critical habitat units represent 11% of the total designated critical habitat for the species (USFWS 2012). This plover breeds and winters along the coasts of Santa Barbara, Ventura, Los Angeles, and Orange counties and on several of the Channel Islands.

Marbled Murrelet (*Brachyramphus m. marmoratus*). This Federally threatened species is found in Washington, Oregon, and California, where it spends most of its life in the nearshore marine environment but nests and roosts inland. There is no critical habitat for this species designated near the project area (USFWS 2016). This murrelet is a very rare late summer, fall, and winter visitor to the Santa Barbara County coast, but a somewhat more regular visitor in late summer in the Vandenberg Air Force Base area (Marantz 1986; Lehman 2014). This species occurs less frequently south of Point Conception, but occasionally is observed off Ventura and Malibu and in Santa Monica Bay (eBird 2017).

California Least Tern. A summer visitor to California, this Federally listed endangered species breeds on sandy beaches close to estuaries and embayments from San Francisco Bay south into Baja California. In the project area, California least terns breed along the coasts of Santa Barbara, Ventura, Los Angeles, and Orange counties. No critical habitat has been designated for this species. Fall migration to wintering grounds in Central and South America begins in late July and ends by mid-September (USFWS 2006).

3.9 MARINE MAMMALS

The waters offshore of Southern California support a diverse marine mammal community (Jefferson et al. 2014a; Carretta et al. 2016a,b; Muto et al. 2016a,b) which includes a variety of whales, dolphins, porpoises, seals, and the southern sea otter (*Enhydra lutris nereis*). All marine

mammals that occur in the project area are protected under the Marine Mammal Protection Act (MMPA), and eight species are Federally listed under the ESA. The blue whale (*Balaenoptera m. musculus*), fin whale (*Balaenoptera physalus physalus*), humpback whale (*Megaptera novaeangliae*), North Pacific right whale (*Eubalaena japonica*), sei whale (*Balaenoptera borealis borealis*), and sperm whale (*Physeter macrocephalus*) are endangered, while the Guadalupe fur seal (*Arctocephalus townsendi*) and the southern sea otter are threatened. All the Federally listed species are under the jurisdiction of the NMFS, except the southern sea otter, which is under the jurisdiction of the USFWS. The following sections provide summaries of the marine mammals that may occur in the project area.

3.9.1 Whales, Dolphins, and Porpoises

At least 8 species of baleen whales and 23 species of toothed whales have been reported from the Southern California Planning Area (Carretta et al. 2016a,b; Jefferson et al. 2014b; Kaplan et al. 2010; Maxon Consulting 2014; Muto et al. 2016a,b; NMFS 2015a–y; 2016a,c,e,f; 2017a–d; Smultea and Jefferson 2014).

In general, the species most often observed in coastal and shelf waters are the humpback and gray whales, and the bottlenose, Risso's dolphin, and long-beaked common dolphins. The sperm whale is observed most often in pelagic waters, and blue whales, fin whales, short-beaked common dolphins, Pacific white-sided dolphins, and Dall's porpoise in coastal, shelf, and pelagic waters (Campbell et al. 2014, 2015; Douglas et al. 2014). The following paragraphs discuss Federally listed threatened and endangered whales, dolphins, and porpoises that may be present in the project area. Additional information on these species is available from NOAA Fisheries (http://www.nmfs.noaa.gov/pr/species/mammals).

Blue Whale. The blue whale is a Federally listed endangered species (USFWS 1970). The Eastern North Pacific stock, which frequents the waters off California, has been estimated to be about 1,600 individuals (Carretta et al. 2016a). Within the project area, blues whales are observed most often in the central and eastern portions of the Santa Barbara Channel (Whale Alert-West Coast 2017). Most observations occur in July and August, with fewer observations in January through April (Širović et al. 2015; Debich et al. 2017; Whale Alert-West Coast 2017). Concentrations of feeding animals have been reported from June through October in the following areas:

- The area of Point Conception/Arguello, close to the Santa Maria Basin platforms and western portion of the Western Santa Barbara Channel platforms;
- Santa Barbara Channel and the San Miguel area, close to the Western Santa Barbara Channel platforms; and
- Santa Monica Bay to Long Beach, close to the San Pedro Bay platforms (Calambokidis et al. 2015).

Fin Whale. The fin whale is Federally listed as endangered, typically occurring in social groups of two to seven individuals. While fin whales may be present year-round off Southern California, the greatest number of observations typically occur in summer (Debich et al. 2017; Whale

Alert-West Coast 2017). Within the project area, most observations have been in the eastern portion of the Santa Barbara Channel (Whale Alert-West Coast 2017).

Gray Whale. The Western North Pacific stock of gray whales is Federally listed as endangered, but the Eastern North Pacific stock is de-listed (USFWS and NMFS 1994). However, it is impossible to visually differentiate between the two stocks, and gray whales from the Western North Pacific stock are rare visitors to the Southern California POCS. Each year, gray whales migrate along the California coast between summer feeding grounds in the Arctic and calving grounds in lagoons on the Baja Peninsula. In the project area, the peak southbound migration is in January, and the peak northbound migration is in March, with individuals observed moving in both directions during January and February (CMLPAI 2009). In the project area, most observations are from the eastern portion of the Santa Barbara Channel, including in the immediate vicinity of the POCS platforms in that area (Whale Alert-West Coast 2017).

Humpback Whale. The humpback whale is Federally listed as endangered. While reported sightings in Southern California waters typically peak in May through September, this species has been observed year-round (Debich et al. 2017; Whale Alert-West Coast 2017). In the project area, relatively high concentrations of feeding whales have been reported from March through September in the Santa Barbara Channel–San Miguel area (Calambokidis et al. 2015), and numerous observations have been in the eastern portion of the Santa Barbara Channel, including in the immediate vicinity of the POCS platforms in that area (Whale Alert-West Coast 2017).

North Pacific Right Whale. The North Pacific right whale is Federally listed as endangered (NMFS 2008b). Sightings of this species off the coast of California and Mexico are rare, and there is no evidence that these areas were ever regularly frequented by this species (Reilly et al. 2008). Although this species has been observed in the past off the Channel Islands in 1981, 1990, and 1992 (Kaplan et al. 2010), there have been no observations in the project area since 1999 (Whale Alert-West Coast 2017). Thus, North Pacific right whales are not expected to occur near any of the POCS platforms.

Sei Whale. The sei whale is Federally listed as endangered. This species is very uncommon, and where it occurs it is usually observed alone or in small groups of two to five animals (NMFS 2015f). Observations in Southern California waters are extremely rare (Kaplan et al. 2010). During extensive surveys conducted between 1991 and 2008, only nine confirmed sightings of sei whales were made in California, Oregon, and Washington waters (BOEM and BSEE 2017b). Thus, sei whales are not expected to occur near any of the POCS platforms.

Sperm Whale. The sperm whale is Federally listed as endangered. This species tends to occur in deep waters (depths >3,280 ft. [1,000 m]) (Kaplan et al. 2010; Maxon Consulting 2014; NMFS 2017c). The sperm whale is widely distributed and may be found year-round in Southern California waters, with peak occurrence from April through mid-June and from the end of August through mid-November (Maxon Consulting 2014). Within the project area, there have been only sporadic observations since 1999, with one observation in March 2004 near the Santa Barbara Channel-East Platforms (Whale Alert-West Coast 2017). However, more than 50 sperm whales, including mothers and calves, were observed off Orange County in October 2014 during a period of unusually warm ocean temperatures (Kim 2015).

3.9.2 Seals, Sea Lions, and Sea Otters

Seven species of marine mammals other than whales and dolphins occur in the project area: two species of true seals (the northern elephant seal and Pacific harbor seal), four species of eared seals (California sea lion, Guadalupe fur seal, northern fur seal, and the Steller sea lion), and the southern sea otter. Although these species are all protected under the MMPA, only the Guadalupe fur seal and the southern sea otter are listed under the ESA. Within the project area, these species occur throughout portions of coastlines of the Southern California POCS. Mainland coastal areas and the northern Channel Islands support numerous haul-out and rookery sites for the Pacific harbor seal, the California sea lion, the Guadalupe fur seal, the northern elephant seal, and the northern fur seal. The following paragraphs discuss the two Federally listed species that may be present in the project area.

Guadalupe Fur Seal. The Guadalupe fur seal was Federally listed as threatened in 1985 and since that time has seen a significant increase in numbers. Breeding occurs almost entirely on Isla de Guadalupe, Mexico, from May to July (CMLPAI 2009; NMFS 2015r). In recent years, several Guadalupe fur seals have been consistently observed at San Miguel Island, and a single pup was reported born in 1997 (Seal Conservation Society 2011; NPS 2018). Aquatic habitats used by the Guadalupe fur seal do not tend to coincide with areas of the POCS platforms.

Southern Sea Otter. The southern sea otter is Federally listed as threatened. The range of the mainland population extends from Marin County in northern California southward to Santa Barbara County (USFWS 2017). Since 1998, southern sea otters have occupied areas south of Point Conception (Tinker et al. 2017), and there is a population near San Nicolas Island off Ventura County. Over the last 15 years, numbers near the project area have steadily increased (Tinker and Hatfield 2016). In California, sea otters live in waters less than 59 ft. (18 m) deep and rarely move more than 1 mi (1.6 km) offshore (Riedman and Estes 1990). Thus, the southern sea otter is not expected to occur near any of the POCS platforms.

3.10 RECREATIONAL AND COMMERCIAL FISHERIES

3.10.1 Commercial Fisheries

About 64 commercial fish and shellfish species are fished in Southern California water, the majority from nearshore coastal waters of Los Angeles to Monterey Counties and from waters just off the Channel Islands. Fishery seasons are established and regulated by the California Department of Fish and Wildlife (CDFW). Seaweeds, especially kelp, are also commercially harvested within the project area (CDFW 2004). Although the harvest of kelp has declined in recent years, an average of 7 million pounds (lb.) (3.18 million kg) of kelp was commercially harvested annually from California waters during the 2006 to 2013 period (CDFW 2014b).

During 2015, landings of more than 49 million lb. (22.2 million kg) of fish and shellfish with a value of approximately $50 million were reported for the Santa Barbara reporting area, and more than 15 million lb. (6.8 million kg), worth approximately $12 million, were reported for the Los Angeles reporting area. Combined 2015 and 2016 commercial catch data for the two reporting

areas indicate that more than 50% of all commercial landings occur from June through September, although November and December each account for more than 10% of the annual catch.

3.10.2 Recreational Fisheries

Southern California is a leading recreational fishing area along the U.S. west coast, where weather and sea conditions allow for year-round fishing. Recreational fishing includes hook-and-line fishing from shore (e.g., piers, docks, breakwaters, and beaches), from private or rental boats, and from commercial passenger fishing vessels. Recreational fishing also includes activities such as dive, spear, and net fishing. Recreational fisheries in Southern California access nearshore and offshore areas, targeting both bottom and mid-water fish species, including surfperch, rockfish, lingcod, yellowtail, yellowfin tuna, Pacific mackerel, and California halibut. August was the month with the greatest portion (more than 25%) of the total annual recreational catch for the two districts; more than 66% of the total recreational catch occurs from June through September.

3.11 SOCIOECONOMICS

The socioeconomic region of interest (ROI) for the Proposed Action encompasses Santa Barbara, Ventura, Los Angeles, and Orange counties. The ROI captures the area that would experience any potential impacts of offshore oil and gas production, where workers would spend their wages and salaries, and where many of the vendors reside that would supply materials, equipment, and services supporting oil and gas production under the proposed action. The following presents ROI data on population, employment, and income.

Population. In 2016, the estimated population within the four-county ROI was more than 14.6 million people. The estimated population within the ROI has increased between 2010 and 2016; the increase over the 6-year period ranges from 3.2% for Ventura County to 5.4% for Orange County. The Statewide population has increased an estimated 5.4% during this time.

Employment and Income. For the ROI in 2016, about 6.9 million people in the civilian labor force were employed, and more than 362 thousand civilian workers were unemployed. Unemployment rates ranged from 4.0% for Orange County to 5.2% for Ventura and Los Angeles counties. Within the ROI, only 6,168 (0.11%) of paid employees were part of the mining, quarrying, and oil and gas extraction sector in 2015. Per-capita annual income ranged from $53,521 for Los Angeles County to $57,749 for Orange County, bracketing the Statewide average of $53,741.

4 ENVIRONMENTAL CONSEQUENCES

This chapter describes the environmental consequences that may occur on the Pacific Outer Continental Shelf (POCS) with implementation of each of the five alternatives, including the No-Action alternative (Section 2.4.1). The evaluation of environmental consequences presented in this Programmatic Environmental Assessment (PEA) focuses on those resources and societal conditions most likely to be affected under each of the five alternatives and on potential impacts that may occur due to the accidental release of hydrocarbons during any of the activities identified for the Proposed Action.

4.1 PROPOSED ACTION AND ALTERNATIVES

Under Alternative 1, the Proposed Action, BSEE will continue to accept and review Applications for Permits to Drill (APDs) for well drilling and conductor installation and Applications for Permits to Modify (APMs) for downhole operations (see Section 2.2.2). These may be submitted for any of the 19 production platforms located on the 38 active leases on the POCS. Table 2-2 presents likely levels of activity that could be newly permitted under the Proposed Action during a 5 year action period. A similar level of activity would occur under Alternative 2, which differs from the Proposed Action with regard to when conductor installation may occur. Alternative 3 is also similar to the Proposed Action, except there would be no conductor installation. Under Alternatives 1–3, BSEE would continue to accept and review APMs on a case-by-case basis for activities included on BSEE Operations Form 0124 but not included in the Proposed Action. Under Alternative 4, BSEE would accept and review APMs only for downhole activities deemed necessary to ensure safe operations or pollution prevention of currently permitted activities. Under Alternative 5, No Action, BSEE would no longer accept or approve any APDs or APMs for any of the operating POCS platforms, including any APMs for activities related to safety or pollution prevention. Previously permitted activities, as well as routine production and safety operations not requiring permitting, would continue under each of the five alternatives.

4.2 ASSESSMENT APPROACH

The evaluation of environmental consequences characterizes potential effects with regard to the spatial extent (e.g., localized around platforms or affecting a much larger portion of the POCS), magnitude (e.g., small vs. large increase in air pollutants, individual biota or populations affected), and duration (e.g., short term [hours, days or weeks] or long term [months or longer]) of any potential effects.

4.2.1 Impacting Factors

For this PEA, impact-producing factors were identified for the activities that could be newly permitted under the Proposed Action (Table 2-1), and these are depicted in Figure 4-1. Under the Proposed Action, natural resources and socioeconomic conditions may be affected by (1) noise generated during conductor installation and drilling, as well as by platform supply vessels and

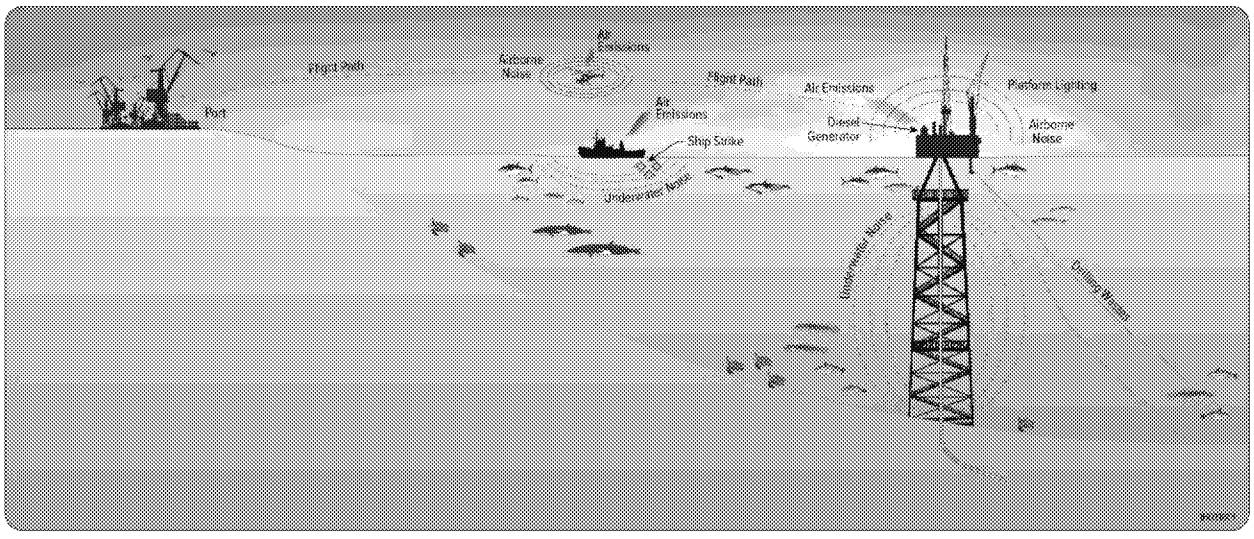

FIGURE 4-1 Impacting Factors Associated with Alternative 1, the Proposed Action

BSEE helicopter flights; (2) air emissions from platform equipment, supply vessels, and helicopters; (3) platform lighting; (4) drilling waste disposal; (5) seafloor disturbance; and (6) support vessel and BSEE helicopter traffic.

The nature, location, magnitude, and duration of each impacting factor (and any subsequent environmental effects) will vary among the activities included in the Proposed Action. For example, noise generated during hydraulic hammering will occur at a specific platform location, will be relatively short in duration but very high in magnitude, and will cease once conductor installation is completed. In contrast, noise from associated supply vessels will be of lower magnitude, occur along shore-to-platform ship routes, be transient along those routes, and cease once conductor installation has been completed.

Natural resources that could be affected by activities permitted under the Proposed Action include air and water, the acoustic environment (i.e., noise levels), and marine and coastal biota and their habitats. Table 4-1 identifies the impacting factors for each of the natural resources evaluated in this PEA. An accidental oil spill, depending on its location, duration, and magnitude, may affect a wide variety natural resources in the POCS.

Sociocultural resources and conditions would largely not be affected under Alternative 1. In addition, newly permitted downhole operations, such as reperforating a portion of an existing well or installing a submersible pump used to enhance production, will have no more than negligible effects, with the possible exception of temporary, short-duration, and very localized minor additional air emissions if diesel engines are used in the operations.

4.2.2 Assessment of Oil Spill Impacts

The Bureaus do not consider oil spills to be a *direct* effect of the Proposed Action, because such accidental releases are neither authorized nor intended to occur. Although the overall risk of an oil

TABLE 4-1 Natural Resources Potentially Affected under Alternative 1, the Proposed Action[a]

Impacting Factor and Source	Resources										
	Air Quality	Water Quality	Offshore Invertebrates and Habitats	Coastal Invertebrates and Habitats	Offshore Fish and EFH	Coastal Fish and EFH	Sea Turtles	Offshore Birds	Coastal Birds and Habitats	Offshore Marine Mammals	Coastal Marine Mammals
Noise											
Conductor installation					X		X	X		X	
Well drilling					X		X	X		X	
Helicopter traffic								X	X	X	X
Ship traffic					X	X	X	X	X	X	X
Air Emissions											
Platform equipment	X										
Helicopter traffic	X										
Ship traffic	X										
Platform Lighting								X			
Turbidity											
Drilling waste discharge		X	X		X		X	X		X	
Conductor installation		X	X		X		X			X	
Support Traffic											
Supply ships							X	X	X	X	
BSEE helicopters							X	X	X	X	X

[a] An X only indicates that the resource category may be affected. It does not imply any level of effect or resulting impact. In some cases, the effect or impact may be negligible.

spill occurring in the POCS has declined over time in part due to declining reservoir pressures, other factors such as human error or equipment failure present a risk of an oil spill, and some small spills (e.g., <50 bbl in size) are reasonably foreseeable as long as oil is being produced.

In the POCS, reservoir pressures have dropped to near zero in the majority of the fields that are now in production, and enhanced production approaches (such as artificial lift) are being used to maintain oil production. Under these conditions, the risk of a loss of well control (i.e., a blowout) resulting in a catastrophic spill is exceedingly small. The largest oil spill in the POCS region occurred in 1969, spilling an estimated 80,000 bbl into the Santa Barbara Channel. Over the next 44-year period (1970 to 2014) a cumulative total of 919 bbl was spilled in the POCS region; the largest spill was a 164-bbl spill from a Platform Irene pipeline in September 1997. However, in the course of day-to-day routine platform operations, certain smaller oil spills (under 50 bbl) have occurred throughout oil and gas activities on the POCS. These smaller spills are reasonably foreseeable and thus expected to continue to occur under all alternatives evaluated in this PEA.

Of the recorded oil spills between 1970 and 2014, only 3.4% (49 of 1,435) were greater than 1 bbl; together these totaled 828 bbl. BOEM estimates that a reasonably foreseeable maximum spill volume for all oil and gas operations on the POCS is 200 bbl, and that there is an 84.4% probability of occurrence of 1.86 spills in the "50 to less than 1,000 bbl" size range, and has identified likely trajectories of potential spills (BOEM and BSEE 2017a,b). BOEM's trajectory analysis identified potentially affected locations, while the Los Angeles—Long Beach Area Contingency Plan (www.wildlife.ca.gov/OSPR/Preparedness/LA-LB-Spill-Contingency-Plan) identifies potentially affected environmental, economic, and cultural sites and resources. An assumed 200-bbl maximum likely oil spill (BOEM and BSEE 2017a,b) would cover a small area and last a short time, resulting in small-scale cleanup and response activities. Therefore, effects on resources from an accidental oil spill of this size at one of the POCS production platforms would be localized and temporary, and would be negligible to minor overall. Due to the maximum 200-bbl spill size and the short-term and temporary impacts that could result to all resources discussed in this EA, oil spills are not discussed further.

4.2.3 Impact Levels

A four-level classification scheme to characterize the impacts that could result with implementation of each of the alternatives considered in this draft PEA. Table 4-2 presents the impact levels used to evaluate potentially affected resources. For biota, these levels are based on population-level effects rather than on effects on individuals.

TABLE 4-2 Impact Levels

Impact Level	Definition
Negligible	• No measureable impacts.
Minor	• Most impacts could be avoided with proper mitigation. • If impacts occur, the resource will recover completely without mitigation once the impacting factor ceases.
Moderate	• Impacts are unavoidable. • The viability of the affected resource or societal condition is not threatened, although some impacts may be irreversible. • The affected resource or societal condition would recover completely if proper mitigation is applied once the impacting factor ceases.
Major	• Impacts are unavoidable. • The viability of the affected resource or societal condition may be threatened. • The affected resource or societal condition would not fully recover even if proper mitigation is applied during the life of the project or remedial action is implemented once the impacting stressor is eliminated.

4.2.4 Cumulative Impacts

The Council on Environmental Quality defines cumulative impacts as those resulting from the incremental impact of an action when added to those of other past, present, and reasonably foreseeable future actions, regardless of the initiator of such other actions (40 CFR 1508.7). Thus,

even minor actions may together produce significant impacts over time through additive or interactive (synergistic) processes.

Potential cumulative effects consider the effects of activities that could be permitted under the Proposed Action on marine and coastal resources, in combination with the effects of other past, ongoing, or future activities on the same resources. Chapter 3 characterizes the current condition of the affected environment within the project area as affected by past and present actions, and Chapter 4 evaluates the potential direct and indirect impacts of the activities that could be newly permitted under the Proposed Action. Cumulative impacts analysis qualitatively considers the current condition of, and stresses on, a given affected resource, along with the resilience and sustainability of that resource. Because activities that could be permitted under the Proposed Action would have no or negligible impacts on archeological resources, areas of special concern, recreation and tourism, or environmental justice, there would be no cumulative impacts on these resources and therefore are not discussed further.

4.2.5 Incomplete or Unavailable Information

The Bureaus used the best available scientific information to prepare this draft PEA. The analyses conducted are based on scientifically credible information that was publicly available at the time this PEA was prepared. Where necessary, extrapolations from existing or new information employing accepted methodologies were used to make reasoned estimates and conclusions regarding both current resource baseline conditions and expected impacts from the alternatives. The subject-matter experts who prepared this draft PEA conducted a diligent search for pertinent information, and the Bureaus' evaluations of impacts are based upon scientifically accepted approaches or methods. The analyses for this PEA did not suffer from the existence of the incomplete or unavailable information. For these reasons, the Bureaus have met their NEPA obligations in this PEA: to consider the best available science and information relevant to the proposed action, alternatives, and impact analyses; and to consider to what extent incomplete or unavailable information impedes that analyses and the ability to make a decision among the alternatives as to whether a Finding of No Significant Impact (FONSI) is appropriate in light of the available and incomplete information (50 CFR 1502.22).

4.3 ENVIRONMENTAL CONSEQUENCES

For each alternative, potential impacts are discussed resource by resource.

4.3.1 Air Quality

The EPA has delegated air quality regulatory control of offshore oil and gas platforms to their corresponding onshore area (COA) air districts: 15 platforms offshore of Santa Barbara County to the Santa Barbara County Air Pollution Control District (SBCAPCD), four platforms offshore of Ventura County to the Ventura County Air Pollution Control District (VCAPCD), and four platforms offshore of the City of Long Beach (near the boundary of Los Angeles County and Orange County) to the South Coast Air Quality Management District (SCAQMD).

Air emission sources associated with the activities that could be permitted under Alternatives 1, 2, and to a lesser extent 3, include equipment used for conductor installation, well drilling and downhole operations, and support vessels transporting supplies such as conductor pipe and drilling materials; and helicopter traffic transporting BSEE inspectors (Table 4-1). These sources would emit criteria pollutants such as NO_X and reactive organic gases (ROGs), hazardous air pollutants (HAPs) such as benzene, and greenhouse gases (GHGs) such as CO_2, as well as small amounts of primary particulate matter (PM) and CO. Of the 19 production platforms currently operating on the POCS, all but four receive their power from onshore electricity generation sources via seafloor cables. Thus, newly permitted conductor installation or drilling employing diesel engines would occur only at Platforms Edith, Harmony, Harvest, and Hidalgo. Any diesel engines used for conductor installation or drilling at these four platforms would be permitted by the appropriate county air districts. There would be no such emissions under Alternatives 4 and 5.

Assuming an average of 16 conductor installations per year over a 5-year period under Alternatives 1 and 2 (Table 2-2), each employing diesel engines, maximum annual emissions of criteria pollutants from conductor installation would be less than 0.05% of the estimated daily emissions of these criteria pollutants from all sources in the four-county area (Table 4-3). Similarly, the estimated 31 tons of CO_2 produced during this same level of conductor installations using diesel engines would also be a tiny fraction of statewide annual GHG emissions, which are estimated at 442 million metric tons CO_2e (Section 3.2.3). Thus, potential impacts of conductor installation on ambient air quality under either alternative would be very localized, short term, and temporary, and would be no more than minor under both alternatives. No such emissions would occur under Alternatives 3, 4, or 5.

Table 4-4 presents estimated average daily emissions during drilling of a single well under Alternatives 1, 2, or 3, assuming the use of a 1,785-hp diesel engine over a 90-day total drilling and testing period.[14] Such emissions represent a negligible percentage of the average daily emissions from the four COA counties (Table 4-4), and no pollutant would exceed the 25-ton (over 12 months) permit exemption threshold for offshore equipment in effect in the Santa Barbara County Air Pollution Control District. Thus, emissions during drilling under any of these three alternatives would have at most minor impacts on air quality. In addition, an estimated 2,900 tons of CO_2 emissions for drilling a single well is 0.00059% of annual statewide emissions of 442 million metric tons CO_2e. Sidetracking would produce similar daily emissions, assuming similar power requirements.

[14] The diesel engine power requirement of 1,785 hp and well construction duration of 90 days are from Table 5.4-1 in Appendix 5.4 of MMS (2001) for delineation drilling in the Bonito formation in the project area using a Mobile Offshore Drilling nit (MODU). A fuel requirement of 257,400 gal of diesel for one well is taken from Appendix Table 5.2.1-2. The 90-day total well construction period includes 23.5 days for drilling; 20.75 days for tripping, casing, and logging; and 27.5 days for testing. The remaining 18.25 days are for other related operations; thus, 90 days is a conservative period for platform-based drilling. Emission factors for criteria pollutants are taken from Table 1 in DieselNet (2017). The emission factor for SO_2 assumes the use of ultra-low sulfur fuel with 15 ppm sulfur content. NOx and ROG are assumed to be 100% and 10%, respectively, of the combined standard, considering the low volatility of diesel fuel. All PM is from engine exhaust is assumed to be $PM_{2.5}$. An emission factor for CO_2 of 10.21 kg CO_2/gal diesel is from EPA (2014).

TABLE 4-3 Projected Air Emissions from Diesel-Powered Conductor Installation

Criteria Pollutant	Average Daily Four-County-Wide Emissions (lb.)	Average Annual Emissions (lb.) Assuming 16 Diesel-Powered Conductor Installations/yr	Average Annual Emission from Conductor Installation as Percentage of Total Daily Emissions
CO	3,970,000	342 (21.4/conductor)	0.009
NO_X	1,090,000	391 (24.4)	0.04
$PM_{2.5}$	131,000	19.6 (1.2)	0.01
SO_2	63,000	0.59 (0.04)	0.0009
ROG	905,000	39.1 (2.4)	0.004

TABLE 4-4 Projected Air Emissions from Diesel-Powered Well Installation

Criteria Pollutant	Average Daily Four-County-Wide Emissions (lb.)	Average Daily Emissions (lb.) per Well Installation, Assuming 90-day Completion Period	Per-Well Emissions (tons) and Percentage of SBCAPCD 25-tpy Permit Exemption Threshold[a]	Average Daily Drilling Emission as Percentage of Average Daily Four-County-Wide Emissions (lb.)
CO	3,960,000	190	8.5 (34%)	0.005
NO_X	1,080,000	351	15.8 (63%)	0.032
$PM_{2.5}$	131,000	11	0.50 (2%)	0.008
SO_2	63,000	0.6	0.027 (0.11%)	0.001
ROG	905,000	35.1	1.6 (6.3%)	0.004

[a] A permit shall not be required for equipment, including associated marine vessels, used for pile driving adjacent to or in waterways, or cable and pipe-laying vessels/barges or derrick barges if the potential to emit of such equipment per stationary source is less than 25 tons per year of any affected pollutant during any consecutive 12-month period (SBCAPCD Rule 202.F.7).

Given an expected 10 new wells and up to 33 sidetracks over a 5-year period (Table 2-2), potential effects of diesel-powered new well drilling and sidetracking on ambient air quality under Alternatives 1, 2, and 3 would be temporary and localized, and result in no more than minor impacts. No such emissions would occur under Alternatives 4 or 5.

Under Alternatives 1 and 2, and to a lesser extent under Alternative 3, as many as 123 additional vessel trips and a similar number of helicopter flights would support conductor installation, drilling, and associated BSEE inspections over a 5-year period (Table 2-2). Emissions from this additional traffic under each alternative would be minimal in comparison to emissions from ongoing routine support vessel traffic and BSEE inspections, and to total air emissions from the four COA counties. Similarly, emissions from platform diesel sources supporting newly permitted downhole operations, such as powering submersible pumps in artificial lift operations, would be periodic and short term, and largely limited to the four POCS platforms that are not electrified. Thus, these activities would produce negligible impacts on air quality in the project area. Because no additional support vessel or helicopter traffic would be expected under Alternatives 4 or 5, there would be no additional emissions from vessel and helicopter traffic under any of these three

alternatives, while authorization of any safety- or pollution prevention-related APMs under Alternative 4 could result in only very small and temporary air emissions, and thus have a negligible impact on air quality.

Under each alternative, air emissions associated with POCS oil and gas activities would continue from currently permitted operations; from routine inspection, maintenance, and repair activities; and from supporting supply ship and helicopter traffic. However, as oil and gas reserves continue to decline, so will production and associated air emissions. With declining reserves and no further authorization of APDs for conductor installation and drilling or of APMs for enhanced production activities, oil and gas production may be expected to decline more rapidly under Alternatives 4 and 5 than under Alternatives 1–3, and air emissions may be expected to similarly decline more rapidly. While the limited approval of some APMs under Alternative 4 may allow some wells to continue operation, under Alternative 5 there would be no such permit approval, and for wells with safety or pollution prevention concerns BSEE would enforce shut-in of the wells. As a result, oil and gas production may decline more rapidly than under Alternative 4 and air emissions may be expected to similarly decline. Thus, air emissions under No Action may be the lowest among all alternatives, although overall impacts on ambient air quality would be negligible.

Table 4-5 presents estimated downstream GHG emissions associated with consumption of the oil and gas that could be produced from new wells and sidetracks under each of the action alternatives. These estimates assume the maximum number of new wells and sidetracks as identified for Alternative 1 (Table 2-2), maximum daily and annual production rates based on maximum daily per well oil and gas production estimates, and the noted emission factors.

TABLE 4-5 Estimated Maximum Downstream Greenhouse Gas Emissions Associated with New Wells and Sidetracking under the Alternative 1—Proposed Action

						Estimated Maximum Annual GHG Emissions		
		Estimated Maximum Annual Production of New Wells		Emission Factor (kg CO_2e)		From Consumption of New Production	As Percentage of GHG Emissions within	
Alternative	Max. No. of New Wells	Oil (bbl/yr)[a]	Gas (Mcf/yr)[b]	Oil (per bbl)	Gas (per Mcf)	MT CO_2e	California	United States
1–3	43	4,826,213	8,197,695	429.6	54.5	2,520,071	0.57%	0.038%
4 and 5	0	0	0	429.6	54.5	0	0.00%	0.000%

[a] Based on a maximum daily per well production estimate of 307.5 bpd from Platform Irene.
[b] Based on a maximum daily per well production estimate of 522.3 Mcf per day from Platform Harmony.
Sources: ARB (2017d); BSEE (2016, 2017a); EIA (2017c); EPA (2014, 2017c).

Under Alternatives 1, 2, and 3, estimated maximum annual downstream GHG emissions from the consumption of new oil and gas production would be about 2.5 million metric tons (2.8 million tons) CO_2e, which accounts for about 0.57% of statewide GHG emissions and 0.038% of U.S. GHG emissions (ARB 2017d; EPA 2017c) (Table 4-5). Because overall oil and gas production on the POCs has been declining steadily since the late 1990s, production from new wells under Alternatives 1, 2, and 3 would likely only slow or maintain the ongoing decline and not act to increase overall production. Thus, the consumption of oil and gas newly produced on the POCS under any of these three alternatives would not be expected to result in increases in GHG emissions. Under Alternatives 4 and 5 (No Action), there would be no new drilling or enhanced production activities, and thus no new production or associated downstream GHG emissions.

4.3.1.1 Cumulative Impacts

Given the estimated negligible to minor potential impacts from newly permitted activities under any of the alternatives, incremental impacts of the Proposed Action and alternatives are not expected to result in any cumulative effects on regional air quality or on climate change, when combined with other ongoing or possible future emissions.

4.3.2 Noise

This section discusses potential noise impacts on the acoustic environment associated with POCS platforms. Later sections of this chapter evaluate the effects of such noise on natural resources (e.g., fish and marine mammals).

Under Alternatives 1 and 2, conductor installation may be carried out either by jet drilling or by impulsive installation using a hydraulic hammer (Appendix B), but no conductor installation would occur under Alternatives 3, 4, or 5. Of these two methods, noise from impulsive installation is of greatest concern, primarily because of its potential to adversely impact marine mammals. This analysis assumes any new conductor installation would be similar to that of the 2014 impulsive installation at Platform Harmony (BOEM 2014b), namely conductor pipe setup and welding taking approximately 3 to 7 hours per pipe section, and pile driving using a hydraulic hammer for 2 to 4 hours for each pipe section, with active hammering for about 5 to 8% of the total installation time (Appendix B). During such installation, noise may emanate from the underwater portion (from the sea surface to the seafloor) and the above–sea-level portion (from the platform and the sea surface) of the conductor.

Because of the absence of available open slots, there would be no conductor installation at Platforms Heritage, Hondo, Henry, or Eureka. In addition, based on operator plans for a 5-year period, no conductor installation is anticipated at any of the four Santa Maria Basin platforms, at three of the Santa Barbara West platforms, at Platform Eureka in the San Pedro Basin, or at Platforms Gina, Habitat, and Henry in the Santa Barbara East platform group (Figure 1-1). Thus, noise impacts from conductor installation under Alternatives 1 and 2 would be limited to only nine of the POCS production platforms (two of the San Pedro Basin platforms and seven of the Santa Barbara East platforms).

During the 2014 conductor installation at Platform Harmony, measured peak mean underwater sound levels at 10 m from the conductor pipe were about 205 dB rms re 1 µPa during pile driving (MacGillivray and Schlesinger 2015). Under the Proposed Action, such underwater sound levels would occur at no more than nine platforms and only during active pile driving. As a result, there would be no widespread or long-term increase in underwater noise levels on the POCS. Thus, impacts on the underwater acoustic environment from pile driving would be short term, temporary, localized, and minor. The potential impacts of noise on marine mammals and other marine life with respect to the NMFS effects thresholds are evaluated in later sections.

A number of mitigation measures are available to reduce sound levels during impulsive conductor installation. Bubble curtains may be used to dampen the transmission of pile-driving noise (based on the physical phenomenon of sound scattering and on the resonance of vibrating air bubbles). Foam-walled and double-walled temporary noise attenuation piles have also been used to reduce underwater sound transmission. Cushions between the hammer and the conductor have been used to dampen the impulse delivered to the piles by the hammer, which reduces airborne noise generation but not the underwater propagation environment (e.g., see MacGillivray and Schlesinger 2014). Under Alternatives 1 and 2, mitigations would be identified and applied on a case-by-case basis at the permitting stage.

Measured mean airborne sound levels on the deck of Platform Harmony during the 2014 pile driving, and without noise mitigation, were about 112 dBA[15] (MacGillivray and Schlesinger 2014). As with the generation of underwater sound, airborne sound from pile driving would occur at no more than nine platforms and only during active pile driving. Thus, there would be no widespread or long-term increase in airborne noise levels on the POCS, and impacts on the airborne acoustic environment from pile driving would be short term, temporary, localized, and minor. Thus, under Alternative 1 impacts on the airborne acoustic environment from conductor installation would be minor.

Sources of underwater drilling noise originating from platforms include diesel-, gas-, or electric-powered engines, the platform itself, and the drill bit. Noise recorded at four platforms on the POCS (Gales 1982) found platform noise to be so weak it was nearly undetectable even alongside a platform during sea states ≥3.[16] The strongest tones from all four platforms were at very low frequencies, around 5 Hz, with received levels of 119–127 dB re 1 µPa at near-field measurement locations. In comparison, recent ambient sound levels near Platform Harmony ranged from 102 to 114 dB re 1 µPa, with a median level of 105 dB re 1 µPa (MacGillivray and Schlesinger 2015). Airborne sound levels from newly permitted drilling operations estimated assuming use of a 1,785-hp diesel engine had a mean source level of 125.2 dBA re 20 µPa (Beranek and Ver 1992).

---

[15] A-weighting (denoted by dBA) is widely used to account for human sensitivity to frequencies of sound (i.e., less sensitive to lower and higher frequencies and most sensitive to sounds between 1 and 5 kilohertz [kHz]), which correlates well with a human's subjective reaction to sound.

[16] Sea state is a measure of the intensity of the ocean's movement as characterized by such parameters as wind speed and wave height (Richardson et al. 1995). Sea states vary from 0, which represents calm conditions, to 9, which is characterized by wind speeds of more than 33 m/s and wave heights of more than 14 m. Sea state 3 is defined as a wind speed of 5.7–8.2 m/s and a wave height of 0.5–1.2 m, which corresponds to typical conditions in the project area.

In contrast to the relatively few platforms where new conductor installation could occur, new well drilling and sidetracking could be permitted under the Proposed Action at any of the POCS production platforms. Underwater and airborne sound generated during drilling and sidetracking would also be short term, temporary, and limited to individual platform locations, and would not result in any long-term increases in noise levels. Thus, under Alternative 1 drilling and sidetracking would have no more than a minor impact on the acoustic environment of the POCS.

Supply vessel and helicopter traffic associated with activities that could be permitted under Alternative 1 would temporarily add to the local noise levels at the platforms, at seaports or airports used by the support vessels and helicopters, and along the traffic routes to and from the platforms. Noise generated by these ships and helicopters would be transient, variable in intensity, and limited in range. Therefore, under Alternative 1 impacts of supply vessel and helicopter traffic on the acoustic environment of the POCS would be negligible.

Under Alternative 2, impacts to the underwater and airborne acoustic environment would be the same as identified for Alternative 1 (ranging from negligible to minor), except there would be no generation of conductor installation-related noise (including that from associated support vessel traffic and helicopter flights) during any conductor installation exclusion period.

Under Alternative 3, there would be no noise generation from conductor installation (or from any associated supply vessel and helicopter traffic). Underwater and airborne noise generated during drilling and authorized downhole operations and supporting vessel and helicopter traffic would otherwise be similar to those under Alternatives 1 and 2, ranging from negligible to minor.

Noise generation at the POCS platforms under Alternatives 4 and 5 would result only from currently permitted operations; routine inspection, maintenance, and repair activities; supply ship and helicopter traffic associated with current production; and additionally for Alternative 4 from any newly permitted safety- or pollution prevention–related downhole operations. None of these activities would add to the ambient noise levels at any of the POCS platforms. With declining reserves and no further authorization of APDs or APMs, oil and gas production may be expected to decline more rapidly under each of these alternatives than under Alternatives 1, 2, or 3, and production-related noise may similarly decline more rapidly. Thus, potential impacts of Alternatives 4 and 5 to the acoustic environment at POCS platforms would be negligible.

4.3.2.1 Cumulative Impacts

Sound is not additive unless noise sources are at a similar level, are relatively close together or a similar distance from a receptor, and occur at the same time. Other noise sources around the project area, including shipping traffic, would be minimally additive with project-related sources because of the separation distance and the nature of platform noise sources, which are intermittent, short term, or limited in range. Thus, the incremental impacts of Alternative 1, the Proposed Action would not result in any cumulative effects on the acoustic environment in the project area.

4.3.3 Water Quality

Under Alternative 1, water quality could be affected by the introduction of turbidity from bottom disturbance during newly permitted conductor installation, and by the discharge of drill cuttings and drilling muds from newly permitted well drilling and sidetracking (Table 4-1). Effects from currently permitted activities (including NPDES-permitted discharges) and from ongoing routine inspection, maintenance, and repair activities would have negligible impacts on water quality.

During conductor installation, there would be a short-term "puff" release of turbidity originating on the seafloor as the conductor contacts the sea floor. Further, as the conductor is driven into the sea floor, smaller puffs of sediment would arise from the sea floor and dissipate down current. This brief increase in turbidity would have a negligible effect on water quality given its small size, episodic nature, and point of origin at the seafloor. Installation of conductors by jet drilling of sediments would similarly produce a plume of turbidity originating from the seafloor. This plume would drift along the seafloor with the prevailing current away from the source point and slowing dissipate and/or settle to the seafloor. The plume would have little effect at shallow depths where most marine life resides. Even with multiple conductors being installed (sequentially, at approximately 14-day intervals) at any single platform, the effects of the associated increases in turbidity would be similarly short term, temporary, and localized, and have minor effects on water quality. In addition, conductor installation would only occur at nine of the POCS platforms, thus further limiting the area of the POCS that could be affected. The total effect of all foreseeable installations that could be permitted under Alternative 1 would likewise be temporary, localized, and minor.

All drilling-, production-, and downhole operations-related discharges at POCS platforms are regulated through NPDES General Permit No. CAG280000 (the NPDES Permit; see Section 3.4.1), and thus are not expected to result in adverse effects on water quality.[17] The NPDES permit sets effluent concentration limits and defines maximum allowable annual discharge volumes for drilling fluids, cuttings and excess cement for each of the producing platforms (EPA 2013a)[18]. Among effluent discharge limitations specified in the NPDES General Permit are limits on total volume, toxicity, presence of free oil, and prohibition of oil-based drilling fluids or diesel.

Permitted open-water discharges of drilling fluids (muds) and cuttings from the drilling platform will introduce turbidity for the duration of drilling, beginning at the point of discharge, which is typically 30–40 m (100–130 ft.) below the sea surface (MMS 2005). Cuttings will fall more quickly through the water column than drilling muds and remain in the water column for a relatively short time (e.g., an hour or less). Cuttings would deposit mostly near platform discharge point due to their large grain size, and have little direct impact on water quality (MMS 2005). However, up to a third of the volume of cuttings would be adhering drilling muds, and these could produce a continuous plume of turbidity emanating from the falling cuttings as well as making up

[17] Note that an exceedance of an NPDES permit limit would not necessarily constitute a significant impact.

[18] Annual limits on cuttings range from 13,350 to 90,000 bbl; for drilling fluids, from 36,650 to 200,000 bbl; and for excess cement slurry, from 1,200 to 6,500 bbl. Permittees must provide EPA verbal notice at least 48 hours prior to the final mud dump upon completion of each well.

a portion of the cuttings pile on the seafloor. Minor concentrations of residual drilling mud chemicals (e.g., clays, lime, bicarbonate, cellulose fiber) could leach from the solid cuttings. However, most operators on the POCS currently dispose of drill cuttings in onshore landfills, and in such cases none of the effects of open-ocean disposal of drill cuttings would occur.

Bulk discharge of drilling muds may occur at the end of use of a mud system (formulation), producing a turbidity plume from the point of discharge.[19] Finer-grained material associated with residual drilling muds would drift farther afield with currents, becoming diluted in the process. Mid-depth and near-bottom currents would disperse drilling mud discharges initially, while bottom currents would further disperse muds via resuspension (MMS 2005). Any effects on water quality from discharged drilling muds would thus be distributed over a larger area and water volume. The NPDES-permitted discharge of drill cuttings and muds would not occur continuously, but rather would be episodic, occurring during drilling. Given the localized, short-term, temporary, and episodic nature of the NPDES-permitted disposal of drilling muds, such disposal would have no more than minor effects on water quality due to minor introduced turbidity.

Under Alternative 2, potential impacts on water quality would be the same as those described for Alternative 1, and be localized, temporary, and minor. However, potential impacts from turbidity associated with conductor installation would not occur during periods of restricted conductor installation. Under Alternative 3, potential impacts of newly permitted activities on water quality would be the same as those identified for Alternatives 1 and 2 (localized, temporary, and minor), but there would be no impacts from turbidity associated with conductor installation.

None of the impacts identified for activities that could be authorized under Alternatives 1, 2, or 3 would occur under Alternatives 4 or 5. Any downhole activities permitted under Alternative 4 in support of safety or pollution prevention would have negligible effect on water quality. Thus, overall impacts on water quality from oil and gas activities at POCS platforms under Alternatives 4 and 5 (No Action) would be negligible.

4.3.3.1 Cumulative Impacts

The NPDES General Permit has, and will continue to, regulate discharges from the POCS platforms related to drilling and production, while similar permits limit other point-source discharges in the region. Since its inception, the NPDES program has continuously improved the quality of receiving waters throughout the country and notably within the project area (Section 3.4.1). Non-point sources, which are more difficult to control and regulate, will continue to contribute runoff loads to waters in the project area. Within this context, other current and future factors that will impact ocean waters in the project area include oil and gas production; oil spills; natural oil seeps; offshore tankering discharges from vessels; POTW and industrial discharges; urban, industrial, and agricultural runoff; storm-water runoff; agricultural and municipal nutrient inputs; and offshore oil and gas infrastructure decommissioning activities. The future permitted platform discharges will add to these inputs and to turbidity generated during conductor installation

[19] If an operator is conducting a drilling program where several wells are planned to be drilled in succession, large portions of the drilling mud mixture maybe retained and refurbished for the next well so that a large mud dump would only occur at the end of the last well.

associated with the Proposed Action. Thus, the incremental impacts of permitted platform discharges and turbidity from new conductor installation drilling under the Proposed Action would not result in any cumulative impacts on water quality.

4.3.4 Marine and Coastal Invertebrates

Under Alternative 1, marine and coastal invertebrates and their habitats may be affected by noise and turbidity generated during conductor installation, and by the permitted discharge of drilling wastes (Table 4-1).

High-amplitude, low-frequency noise and vibration from pile driving could temporarily affect nearby marine invertebrates (Edmunds et al. 2016). Invertebrates could experience physical damage to organs and masking of intraspecific communications, while species that are more mobile could temporarily leave the area during pile driving (Hawkins and Popper 2017). Studies on individual invertebrate species have shown mixed results; some finding no detectible effects and others reduced larval growth and development (Normandeau Associates 2012; Edmonds et al. 2016). Population-level impacts are unlikely because of the temporary nature, short duration, and limited range of the noise generated during conductor installation. Thus, any impacts on marine invertebrates from conductor installation-related noise are anticipated to be temporary and no more than minor. Because of the distance from the POCS platforms to coastal areas, noise from conductor installation is not anticipated to affect coastal invertebrates. Any turbidity generated during conductor installation would dissipate within a short time (see Section 4.3.3) and result in no more than temporary, short-term, and localized minor impacts on benthic organisms and their habitats in the vicinity of platforms where conductor installation was occurring, and would not affect coastal invertebrates.

Any effects on marine invertebrates, such as displacement of mobile species, of drilling noise would be negligible because of the low intensity and intermittent nature of the drilling noise. Turbidity (and subsequent sedimentation) generated during the NPDES-permitted open-water discharges of drilling waste could impact marine invertebrates and habitats in the vicinity of the platforms were such discharges would occur. Past studies on the POCS indicate that discharged drilling muds may spread over several kilometers of seafloor (Battelle 1991, cited in MMS 2001). Following the cessation of drilling waste discharges, the impacts on soft-bottom invertebrate communities would be primarily related to changes in sediment grain size on the ocean floor near the platform (Battelle 1991, cited in MMS 2001). Prior studies also indicate that NPDES-permitted discharges of drilling wastes at POCS platforms have not caused detectable changes to nearby hard-bottom communities (Diener and Lissner 1995), and that the effects of discharged drilling muds are largely limited to within 1 km of the discharge site (Lissner et al. 1987, cited in MMS 2001). Thus, turbidity from the discharge of drilling wastes generated during new drilling would result in no more than temporary, short-term, and localized minor impacts on marine invertebrates and their habitats near the platforms. No impacts on coastal invertebrates and their habitats would occur, due to their distance from the POCS platforms.

Two endangered abalone species (*Haliotis sorenseni* and *H. cracherodii*) occur on the POCS and may be affected by conductor installation and well drilling. Populations of the endangered white and black abalone have been declining for decades, primarily due to overharvesting and disease

(66 FR 29054; 74 FR 1937). The NMFS critical habitat rule (76 FR 66805) identified increased sedimentation, drilling muds, and oil spills as having the potential to affect endangered black abalone. Neither endangered abalone species is likely to be affected. Both these species are very rare in the Southern California Bight (Pondella et al. 2012; Blanchette et. al 2015), and the POCS platforms occur in waters deeper than those inhabited by abalone. Thus neither species is likely to be exposed to turbidity and sediment plumes associated with conductor installation and drilling waste discharge. In addition, bottom-disturbing activities would primarily affect soft-bottom habitats where endangered abalone would not be found. A 2017 Biological Assessment (BA) prepared for the NMFS (BOEM and BSEE 2017b) regarding the potential effects of POCS oil and gas operations on the federally listed species identified only oil spills as a potential impacting factor for these abalone species. The BA made a determination that ongoing oil and gas activities are "not likely to adversely affect" these species. Similarly, the EPA found that routine discharges under the NPDES permit would not affect the white abalone, or any other listed species (EPA 2013b). Thus, impacts on the abalone from activities that could be permitted under Alternative 1 would be negligible.

Under Alternative 2, potential impacts on marine invertebrates would be the same as for Alternative 1 (localized, short term, temporary, and ranging from negligible to minor). Potential minor impacts would be primarily associated with temporary localized increases in turbidity. Because marine invertebrates do not generally exhibit seasonal migrations, seasonal restrictions of conductor installation would not decrease the severity of any conductor-installation-related effects on marine invertebrates.

Under Alternative 3, there would be no permitting of conductor installation. Therefore, impacts under this alternative would be primarily associated with turbidity generated during drilling waste discharge. These impacts would be similar to those under Alternatives 1 and 2: localized, short term, temporary, and minor.

None of the effects identified for Alternatives 1, 2, and 3 would occur under Alternatives 4 or 5. Effects from any limited downhole activities that could be authorized under Alternative 4 would be negligible. Thus, overall impacts on marine and coastal invertebrates under Alternatives 4 or 5 would be negligible.

4.3.4.1 Cumulative Impacts

Marine and coastal invertebrate habitat and communities on the POCS have been affected by past and ongoing activities such as commercial and recreational harvesting, beach development, subsea cable installation and operations, and point-source and non-point-source discharges. Under the Proposed Action, conductor installation would generate additional seafloor disturbance (a turbidity plume), and drilling wastes would increase turbidity in the water column and sedimentation of the seafloor. However, these effects would be temporary and affect only a small area. The Proposed Action and the other action alternatives would have temporary and no more than minor incremental impacts on marine invertebrates and their habitats, and would not result in cumulative impacts on benthic resources of the POCS.

4.3.5 Marine and Coastal Fish and Essential Fish Habitat

Under Alternative 1, marine and coastal fish and essential fish habitat (EFH) may be affected by noise and turbidity during conductor installation, by noise and the discharge of drilling wastes during drilling, and by noise from supply vessels supporting conductor installation and drilling (Table 4-1). Ongoing permitted oil and gas production activities, supply ship and helicopter traffic, and routine inspection, maintenance, and repair activities would have little to no effect on marine fish and EFH.

The exposure of fish to pile-driving noise depends not only on the intensity and duration of the pile driving, but also on the mobility of the fish. The effects of any such exposure also depend on these factors, as well whether exposed fish have swim bladders or not. Mobile fish would be able to flee the sound source, thus reducing exposure and associated effects. Laboratory studies of fish exposed to pile-driving noise found damage primarily to the swim bladder, while fish with no swim bladder were minimally impacted (Casper et al. 2016). Although they would be nearest to the noise and vibration source, bottom-dwelling fish generally lack a swim bladder and may be less sensitive to noise. Field studies found minimal avoidance by fish of pile-driving sound up to 162 dB (Iafrate et al. 2016). Modeling suggests that sound levels exceeding NMFS safety recommendations would likely be restricted to within a few meters from the source (MacGillivray and Schelsinger 2014), and thus would only affect fish nearest the platform where conductor installation is occurring. Overall impacts on marine fish from pile-driving noise are anticipated to be temporary, short term, localized, and minor, and thus no population-level impacts on fish are expected under Alternative 1.

Conductor installation will result in a temporary and localized increase in turbidity due to sediment resuspension (see Section 4.3.3), which could temporarily displace fish from the area, reduce feeding efficiency, and affect gills of exposed fish. However, due to the temporary and localized nature of any such increases in turbidity, exposure of marine fish to turbidity from conductor installation is expected to be localized, short term, and temporary, and to result in no more than minor impacts on affected fish.

There is no evidence that fish populations on the POCS have been adversely affected by noise from past well drilling activities (NCE 2007). While drilling noise has the potential to displace fish, noise levels would be much less than during conductor installation and would not be reasonably expected to injure or kill fish. Therefore, no population-level impacts are expected from drilling under Alternative 1, and overall impacts of drilling noise on fish (temporary displacement) would be negligible.

The NPDES-permitted discharge of drilling muds can spread over several kilometers from the discharge point, depending on discharge depth, regional hydrodynamics, and the characteristics of the drill muds (Battelle 1991, cited in MMS 2001). The resultant turbidity could cause mobile fish to avoid the area of the turbidity plume. Studies of the effects of discharged drilling muds and cuttings found no changes to nearby hard-bottom communities (Diener and Lissner 1995). Shell mounds consisting of discharged drilling solids and shell scrapings from platforms were not found to contaminate seafloor EFH (Bemis et al. 2014). Thus, drilling waste discharge would have no

more than temporary, short-term, and localized minor impacts on marine fish and their soft-bottom, hard-bottom, and water column habitat (including EFH).

Noise generated by ship traffic supporting conductor installation and drilling could affect nearby fish. Although as many as 123 support vessel trips could be associated with Alternative 1 to support conductor installation and well drilling (Table 2-2), any associated noise disturbance of fish would be very localized, short term, and transitory (e.g., along the ship route between a platform and a port of call), and ship noise levels would be far below levels that cause injury in fish. Impacts on fish from additional vessel traffic would thus be negligible.

The potential impacts of Alternative 1 on marine fish and EFH discussed above may apply to ESA-listed species in Southern California waters. The scalloped hammerhead shark has shallow-water nursery areas in the northern Gulf of California and Bahía Almejas on the Pacific coast of Baja California Sur, which would not be affected by any of the activities that could be permitted under Alternative 1. The geographic range of the Southern California steelhead includes the project area (Section 3.6.3). The EPA concluded that regulated discharges would have no effect on USFWS or NMFS listed species, including the steelhead trout (EPA 2013b). Furthermore, critical habitat for the Southern California steelhead includes only rivers; therefore, no impacts on critical habitat are expected to result from routine oil and gas production activities. In addition, as for other marine fish in the area, any exposure of, and impacts on, the steelhead trout under Alternative 1 from noise, bottom disturbance, and turbidity would be temporary, short term, and localized, and not expected to impact the Southern California population of this species, which is unlikely to be common in the vicinity of the POCS platforms.

Under Alternative 2, potential impacts on marine and coastal fish and EFH would be the same as those described for Alternative 1, namely short-term, localized, and temporary minor impacts from conductor installation (noise and turbidity) and drilling waste discharge (turbidity). However, potential impacts associated with conductor installation would not occur during periods of restricted conductor installation. Potential impacts under Alternative 3 would be the same as those identified for Alternatives 1 and 2, except there would be conductor installation-related impacts on marine fish and EFH. Potential impacts would be associated with drilling waste discharge, and would be localized, short term, temporary, and minor.

None of effects on marine fish and EFH identified for Alternatives 1, 2, or 3 would be expected under Alternatives 4 or 5. Any downhole operations authorized under Alternative 4 to ensure safety or pollution prevention would have negligible impacts on marine fish or EFH. Thus, the overall impacts of Alternatives 4 and 5 on marine fish and EFH would be negligible.

4.3.5.1 Cumulative Impacts

Activities that have historically caused adverse impacts on EFH and fish communities on the POCS include noise, dredging, dredging discharge, wastewater discharge, oil and hazardous waste spills, coastal development, agricultural runoff, and commercial and recreational fisheries. Noise, seafloor disturbance, and discharge of drilling wastes associated with Alternative 1 represent minor, temporary, and localized incremental increases in impacts on fish and EFH. Such activities

would contribute negligible incremental increases in POCS noise levels and would not result in cumulative impacts on fish, including ESA-listed fish species.

4.3.6 Sea Turtles

Under Alternative 1, activities potentially affecting sea turtles include conductor installation, drilling, open-water disposal of drilling wastes, and supply ship and BSEE helicopter traffic (Table 4-1). Ongoing permitted oil and gas production activities, supply ship and helicopter traffic, and routine inspection, maintenance, and repair activities would have little to no effect on sea turtles. Considering their rarity in Southern California waters of the project area, exposure of any of the five sea turtle species to these activities would be minimal.

Under Alternative 1, sea turtles may be affected by turbidity and noise generated during pile driving of conductors. Potential effects may include behavioral disruptions, displacement or reduction of prey, and injury or death (PEPC 2012a,b; Popper et al. 2014), although mortality from pile-driving noise has not been documented. Noise levels generated during pile driving may injure sea turtles or disrupt their behavior. Sea turtles would be expected to move away from areas of auditory discomfort, so physical injury from pile driving noise is not anticipated. However, pile-driving noise may elicit temporary avoidance or displacement from around the platforms where conductor installation is occurring, and affect behaviors such as foraging. Because sea turtles do not rely on acoustics for foraging or other behaviors, the extent of any behavioral effects is unclear. In its assessment of conductor installation at Platform Harmony, NMFS (2014a) concluded that conductor installation at that platform using pile driving would not adversely affect sea turtles. Because pile driving would be limited to only nine platforms, and would be short term and temporary, and because sea turtles are scarce in the project area, it is unlikely sea turtles would be close enough to be harmed by pile driving sounds. Overall, conductor installation would have negligible impacts on sea turtles. Noise mitigation for pile driving (Section 4.3.2) would mitigate potential impacts on sea turtles, while visual monitoring, soft-start (ramp-up) procedures, and shut-down protocols may further reduce the likelihood of impacts.

Under Alternative 1, sea turtles could be affected by drilling noise and by the open-water disposal of drilling waste. Whereas sea turtles are most sensitive to low-frequency sounds in the 50 Hz to 1.6 kHz range (CSA Ocean Sciences Inc. 2014), drilling noise is strongest at even lower frequencies (around 5 Hz; Section 4.3.2) and so may be less likely to disturb sea turtles. If present during discharge of drilling wastes, sea turtles would avoid the resultant sediment plume, and any impacts such as disruption of feeding would be short term, very localized, and likely to affect very few individuals. Because of the temporary and localized nature of well drilling and the general scarcity of sea turtles in the project area, impacts on sea turtles from well drilling noise and waste discharge will be negligible.

Ship traffic has been reported to startle sea turtles, producing stress and increasing collision risk (NRC 1990), and such effects may occur with the additional support ship traffic under Alternative 1. Most such effects would be short term, temporary, and localized to the ship routes, and would affect very few individuals, and thus likely have negligible impacts on sea turtles. However, collisions with supply ships may have moderate impacts, because a strike may result in the injury or death of the affected individual. However, collisions are unlikely, because sea turtles

are infrequent in the project area and spend less than 4% of their time at the surface (PEPC 2012a,b). Safe vessel operations to limit vessel strikes, such as limiting vessel speeds and avoiding areas where sea turtles are observed, would further reduce the likelihood of ship strikes.

Under Alternatives 2 and 3, potential impacts on sea turtles would be the same as those described for Alternative 1 (localized, short term, temporary, and negligible to minor). However, under Alternative 2 potential strikes from supply ships supporting conductor installation would not occur during periods of restricted conductor installation. Although sea turtles are rare in the area, they are most likely present in Southern California during warm water months (NMSP 2008). Thus a summer restriction period would minimize potential ship strikes during that time. Under Alternative 3, there would be no conductor installation impacts.

None of the impacts identified for Alternatives 1, 2, or 3 would be expected under Alternatives 4 or 5. Any downhole operations authorized under Alternative 4 to ensure safety or pollution prevention would have negligible impacts on sea turtles. Similarly, ongoing permitted oil and gas production activities, supply vessel and helicopter traffic, and routine inspection, maintenance, and repair activities would have little to no effect on sea turtles, with the exception of possible minor impacts from ship strikes. However, in the absence of new drilling or enhanced production activities, oil and gas production on the POCS may decline more rapidly under Alternatives 4 and 5 than under the other alternatives. As a result, supply vessel traffic servicing the platforms may be expected to decline as well, thus reducing the potential for ship strikes.

4.3.6.1 Cumulative Impacts

The 2017 NMFS BA (BOEM and BSEE 2017b) identifies collisions and oil spills as a potential impacting factor for the leatherback, loggerhead, green, and olive ridley sea turtles and made a determination of "not likely to adversely affect" from ongoing oil and gas activities for each of these species, noting little or no spatial overlap with ongoing operations. Under Alternative 1, impacts on sea turtles from proposed activities would be added to impacts from entanglement or incidental capture in fishing gear, vessel strikes, ingestion or entanglement in marine debris, environmental contamination, and disease. In areas outside of Southern California, impacts include those from loss of nesting habitat, beach armoring, artificial light, harvesting of eggs and meat, and non-native vegetation (Kaplan et al. 2010; NMFS 2014b,c; NMFS 2016a,b). Because Alternative 1 would add a negligible incremental increase in ship strikes on the POCS, and considering the different nature most other impacts to sea turtles (almost exclusively non-oil and gas related), this alternative would not result in significant cumulative impacts on sea turtles.

4.3.7 Marine and Coastal Birds

Under Alternative 1, impacting factors that could affect marine and coastal birds include conductor installation and drilling noise, platform lighting, drilling waste discharge, and support vessel and BSEE helicopter traffic (Table 4-1). Ongoing permitted oil and gas production activities, supply ship and helicopter traffic, and routine inspection, maintenance, and repair activities would have little to no effect on marine and coastal birds and their habitats.

Impacting factors associated with conductor installation include noise from pile driving and platform lighting. Birds on the water surface, perched on the platform, or flying near the platform could be harassed by exposure to pile-driving noise, but may be expected to leave the area before injury could occur. Diving birds such as diving ducks, cormorants, and pelicans could be exposed to impulsive underwater sounds from pile driving. However, impacts are unlikely, because conductor installation would occur beneath the platform where diving birds are not expected to congregate or dive. Exposure of marine birds to pile-driving noise would be temporary and minimal. In addition, because of the distance of the POCS platforms from the coast, birds in coastal habitats would not be affected by airborne sound generated at platforms during conductor installation. Because noise from conductor installation will have no more than temporary and localized effects on marine birds and no effect on coastal birds, overall impacts of conductor installation on birds would be minor. In addition, mitigation such as gradually ramping up sound levels would encourage most birds to leave the platform area before underwater noise reached potentially injurious levels (BOEM 2014c).

Nighttime lighting of offshore structures, including POCS platforms and commercial and recreational boats, may cause disorientation, mortality from collisions with lighted structures, and interruption of natural behaviors (BOEM and BSEE 2017b). All the POCS platforms are currently well lit at night, and any additional lighting associated with conductor installation under Alternative 1 would be temporary, short term, and limited to only a few POCS platforms. Thus, this additional lighting would have a negligible impact on marine and coastal birds.

Marine and coastal birds could be affected by drilling noise and drilling waste discharges. Underwater noise levels from drilling would be only marginally greater than ambient levels around the platforms (Gales 1982; MacGillivray and Schlesinger 2015), and well below noise levels generated during conductor installation (Section 4.3.2). Seabirds are attracted to offshore structures (BOEM 2016) and show no evidence of being adversely affected by drilling noise. Diving birds may be exposed to turbidity plumes resulting from NPDES-permitted drilling waste discharge, but such exposure would be unlikely and short term. Any associated impacts would most likely be indirect, consisting primarily of the temporary displacement or reduction of prey species within the plume area, and would affect only birds that can dive deep enough to encounter the plume. Thus, impacts on marine birds would be negligible.

Because of the transitory nature of support vessel and BSEE helicopter traffic that would occur under Alternative 1, and the mobility of marine birds, it is unlikely that marine birds will be affected by support vessel and helicopter traffic. Although support vessel and helicopter traffic may elicit an avoidance responses in birds present along the ship and helicopter routes and at the platforms, any such disturbance would be occasional and transient, and any resultant impacts would be negligible.

Under Alternatives 2 and 3, potential impacts would be similar to those described for Alternative 1. However, potential impacts from noise and support vessel traffic during conductor installation would not occur under Alternative 2 during periods of restricted conductor installation, and they also would not occur at any time under Alternative 3. Thus, overall impacts under either of these alternatives would be negligible.

None of the effects on marine and coastal birds identified for Alternatives 1, 2, and 3 would be expected under Alternatives 4 or 5, and any downhole operations authorized under Alternative 4 to ensure safety or pollution prevention would have negligible impacts. Previously permitted activities, supply vessel and helicopter traffic, and routine inspection, maintenance, and repair activities would continue to occur and would have little to no effect on marine and coastal birds. Thus, overall impacts of Alternatives 4 and 5 on marine and coastal birds would be negligible.

4.3.7.1 Cumulative Impacts

Because the impacts of Alternative 1 on marine and coastal birds would be negligible, there would be no incremental increase in impacts from ongoing habitat loss, bird collisions, and stressors from other land- and ocean-based human activities (Halpern et al. 2009). The 2017 BA (BOEM and BSEE 2017a) identified an oil spill as a potential impacting factor for four federally listed bird species, and artificial lighting and noise as additional factors for one species. A "likely to adversely affect" determination was made only for an oil spill and only for the western snowy plover and the California least tern. These are both coastal species that would be unlikely to be exposed to a 200-bbl maximum spill anticipated for Alternative 1 (Section 4.2.2). Thus, this alternative would not result in cumulative impacts on marine and coastal birds, including ESA-listed species.

4.3.8 Marine Mammals

Under Alternative 1, marine mammals may be affected by noise generated during conductor installation and drilling, by exposure to turbidity associated with drilling waste discharge, and by disturbance from or interactions with support vessel and BSEE helicopter traffic (Table 4-1). Ongoing permitted oil and gas production activities, supply ship and helicopter traffic, and routine inspection, maintenance, and repair activities would have little to no effect on marine mammals.

The primary concern for conductor installation is harassment from noise. The Marine Mammal Protection Act (MMPA) amendments of 1994 define harassment as any act of pursuit, torment, or annoyance, which may cause Level A or Level B harassment. Level A harassment has the potential to injure a marine mammal or marine mammal stock in the wild. Level B harassment does not have injury potential, but rather the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. The NMFS (2017g) has developed interim threshold sound levels corresponding to MMPA Level A (injury) and Level B (behavioral disturbance) harassments for cetaceans and pinnipeds (Table 4-6).

Impulsive pile-driving sound can cause behavioral changes and auditory masking in marine mammals. Masking is the obscuring of sounds of interest (e.g., sound of prey or predators) by other, stronger sounds, often at similar frequencies (Erbe et al. 2016). Pile-driving sound would likely be within the audible range of marine mammals present in the project area, which ranges from 7 Hz to as high as 160 kHz (BOEM 2016; NMFS 2016f).

TABLE 4-6 NMFS Interim Sound Threshold Guidance

Criterion	Criterion Definition	Threshold
	In-water acoustic thresholds (excludes tactical sonar and explosives)[a]	
Level A	PTS[b] (injury) conservatively based on TTS[b]	190 dB_{rms}[b] for pinnipeds 180 dB_{rms} for cetaceans
Level B	Behavioral disruption for impulsive noise (e.g., impact pile driving)	160 dB_{rms}
Level B	Behavioral disruption for non-pulse noise (e.g., vibratory pile driving, drilling)	120 dB_{rms}[c]
	In-air acoustic thresholds[d]	
Level A	PTS (injury) conservatively based on TTS	None established
Level B	Behavioral disruption for harbor seals	90 dB_{rms}
Level B	Behavioral disruption for non-harbor seal pinnipeds	100 dB_{rms}

[a] All decibels referenced to 1 micro-Pascal (re: 1 µPa), and all thresholds are based on root mean square (rms) levels.

[b] PTS = permanent threshold shift; TTS = temporary threshold shift, dB = decibel.

[c] The 120-dB threshold may be slightly adjusted if background noise levels are at or above this level.

[d] All decibels referenced to 20 micro-Pascals (re: 20 µPa). Note all thresholds are based on rms levels.

Source: NMFS (2017e).

Modeling of underwater and airborne sound transmission from conductor installation at Platform Harmony estimated underwater pile-driving sound exceeding the Level A (injury) threshold to extend from the conductor out 54 m (177 ft.) for cetaceans and out to 9 m (30 ft.) for pinnipeds (Table 4-7) (MacGillivray and Schlesinger 2015). The estimated maximum distance at which the Level B (behavioral disturbance) threshold was exceeded was 1,189 m (3,900 ft.) for both cetaceans and pinnipeds (Table 4-7). Modeled airborne sound levels exceeding Level B harassment extended out to 46 m (150 ft.) from the conductor pipe for harbor seals and out to 14 m (46 ft.) for all other pinnipeds (Table 4-7) (MacGillivray and Schlesinger 2014). Similar threshold distances would apply at other platforms on the POCS during conductor installation. Airborne sound from pile driving would occur at a few platforms, would be brief and temporary, and would not result in any long-term increase in airborne noise levels on the POCS.

Noise can cause permanent threshold shifts (PTSs) or temporary threshold shifts (TTSs) in the hearing of marine mammals. If hearing is impaired for hours or days, the impact may be ecologically significant (Kastelein et al. 2015). Table 4-8 summarizes the PTSs and TTSs for marine mammal hearing groups. The TTS is often used as the maximum desirable noise exposure criteria for marine mammals (Duncan and McCauley 2008). Because the TTS levels are similar to the Level A and Level B threshold levels, threshold levels may extend similar distances from the conductor pipe during pile driving.

TABLE 4-7 Maximum Distances (in meters) from the Conductor Pipe at Platform Harmony for Interim Level A and Level B Exposure Thresholds to Marine Mammals Based on Maximum Hammer Energy (90 kJ)

	Underwater				Airborne[a]	
	Level A Exposure[b]		Level B Exposure[c]		Level B Exposure[c]	
Marine Mammal Group	Threshold (dB_{rms})[d]	Maximum Distance (m)	Threshold (dB_{rms})[d]	Maximum Distance (m)	Threshold (dB_{rms})[e]	Maximum Distance (m)
Cetaceans	180	54	160	1,189	not applicable	
Pinnipeds (harbor seals)	190	9	160	1,189	90	46
Pinnipeds (non-harbor seals)	190	9	160	1,189	100	14

[a] NMFS has not established an interim threshold for Level A exposure.

[b] Interim exposure levels for potential to injure a marine mammal or marine mammal stock in the wild.

[c] Interim exposure levels for potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.

[d] Rms pressure based on 1 µPa for underwater decibels.

[e] Rms pressure based on 20 µPa for airborne decibels.

Sources: Howorth (2014); Maxon Consulting, Inc. (2015); MacGillivray and Schlesinger (2015).

TABLE 4-8 Summary of PTS and TTS Acoustic Thresholds for Marine Mammals

	PTS Onset Acoustic Thresholds (Received Level)		
Hearing Group	Impulsive	Non-impulsive	Weighted TTS Onset Threshold
Low-frequency Cetaceans	219 dB (peak) 183 dB (cumulative)	199 dB (cumulative)	
Mid-frequency Cetaceans	230 dB (peak) 185 (cumulative)	198 dB (cumulative)	178 dB
High-frequency Cetaceans	202 dB (peak) 155 dB (cumulative)	173 dB (cumulative)	153 dB
Phocid Pinnipeds (underwater)	218 (peak) 185 (cumulative)	201 dB (cumulative)	181 dB
Otariid Pinnipeds (underwater)	232 dB (peak) 203 dB (cumulative)	219 dB (cumulative)	199 dB

Source: NMFS (2016f).

Assuming threshold exceedance distances similar to those estimated for Platform Harmony, under Alternative 1 the potential for injury or TTS during pile driving would be limited to within 60 m (200 ft.), and behavioral disturbance would be limited to within 1,200 m (3,900 ft.) of a platform. It is unlikely that any large cetaceans (i.e., whales) would be present within these distances, although smaller cetaceans (e.g., dolphins), especially pinnipeds, are more likely to be present

within such distances. However, due to the nature of impulsive pile driving (Section 4.3.2), exposure to such noise levels would be intermittent and short term, and marine mammals would be expected to quickly leave the area with the onset of hydraulic hammering. Thus, conductor installation has the potential to result in minor to moderate impacts on marine mammals.

Possible mitigation measures for Level A and Level B harassment of marine mammals during impulsive conductor installation include visual monitoring, passive acoustic monitoring, ramp-up (soft-start) procedures, and shutdown protocols. Further mitigations include acoustic thresholds in combination with corresponding buffer and exclusion zones (NMFS 2014a). NMFS-qualified Protected Species Observers may conduct visual monitoring during active installation. Emergency shutdown procedures for North Pacific right whales and blue, fin, sei, humpback, or sperm whales may also be undertaken. Ramp-up procedures would also mitigate potential noise impacts on marine mammals, including pinnipeds that haul out on platforms (BOEM 2014b), allowing any nearby animal to flee the area before the hammer energy reaches maximum levels.

BOEM and BSEE do not anticipate a Level A "take" (i.e., injury or death) of any marine mammals caused by sound from impulsive conductor installation. In the Pacific, when disturbance of marine mammals is anticipated on a given installation, operators are expected to obtain incidental harassment authorization (IHA) from the NMFS. An intra-service or joint-agency ESA consultation with NMFS would be conducted when specific project information becomes available (BOEM and BSEE 2017b). The Bureaus expect operators to obtain an IHA from the NMFS before any conductor installation could occur, and mitigations would be developed and applied to the extent needed to meet the requirements of the IHA.[20] To issue such an IHA, NMFS would be required to find, among other things, that the activity will not result in more than a negligible impact on the species or stock and that it will result in the taking of only small numbers of marine mammals. NMFS would also impose appropriate mitigations to effect the smallest practicable adverse impact on the species. For these reasons, conductor installation is expected to result in only negligible impacts with application of an IHA.

Marine mammals may be affected by drilling noise and by turbidity plumes generated during permitted open-water discharge of drilling waste. Drilling noise typically falls between 4.5 and 30 Hz, which is generally below reported hearing ranges for marine mammals (Kaplan et al. 2010). It is strongest at very low frequencies, peaking at 5 Hz (BOEM 2012), with highest frequencies of about 1.2 kHz (BOEM and BSEE 2017b). Because of the relatively small amount of drilling expected under Alternative 1 (Table 2-2), the temporary duration of drilling, and the general scarcity or irregular occurrence of marine mammals in the vicinity of the POCS platforms, exposure of marine mammals to drilling noise would be only occasional and temporary. Drilling noise would not cause hearing effects, and exposed individuals would likely move away from the source (BOEM 2012). Thus, impacts from drilling noise on marine mammals would be negligible.

[20] An IHA may be issued under Section 101(a)(5)(D) of the MMPA for no more than a 1-year period (but may be renewed for additional terms) and applies if the action results in harassment only. A Letter of Authorization (LOA) under Section 101(a)(5)(A) and issued pursuant to incidental take regulations would apply if the action results in harassment only but is planned for multiple years (up to five), or if the action results in serious injury or mortality. The issuance of an Incidental Take Authorization, while not anticipated under the proposed action, would require NMFS to comply with both NEPA and Section 7 of the Endangered Species Act as well.

Permitted open-water discharge of drilling waste may cause marine mammals to avoid the resultant turbidity plumes (PEPC 2012a,b). Given the small amount of anticipated drilling, disturbance of marine mammals by such turbidity plumes would have negligible impacts.

Under Alternative 1, marine mammals may be affected by ship and helicopter noise or by collisions with supply vessels supporting conductor installation and well drilling (Table 2-2). Although ship noise can disturb animals in the immediate vicinity of the ship, any disturbance would be transitory (BOEM 2012). Support vessel sound levels would be ≤180 dB, which are similar to those of larger commercial fishing vessels in the area (BOEM and BSEE 2017b). However, broadband sound levels for service vessels are in the range of 150 to 170 dB, which is within the audible range for all cetaceans and pinnipeds, and may exceed the NMFS threshold for Level B harassment for non-pulse noise (Table 4-7). Thus, noise from support vessels may elicit a startle and/or avoidance reaction, or mask sound reception. Because of the limited routes support vessels would take to and from platforms, and the temporary and transient nature of the vessel traffic, impacts on marine mammals from noise generated by additional support ship trips under Alternative 1 would be no more than minor. Underwater sound from helicopter overflights may be within the frequency hearing range of most marine mammals (BOEM 2016), and thus may affect marine mammals. Occasional overflights may elicit a startle response in cetaceans due to noise or presence. However, minimal impacts are expected. Helicopters fly more than 500 ft. above the water and most cetaceans are submerged the majority of the time (BOEM and BSEE 2017b). Sound levels in water generated from helicopter flyovers have been reported at 109 dB re 1 µPa (BOEM 2014b), well below Level A, Level B, and TTS levels. Thus, impacts of helicopter overflights on marine mammals will be transient, temporary, and negligible to minor.

Under Alternative 1 there could be up to 123 additional support vessel trips, and marine mammals could be injured or killed in collisions with these ships. Slow-moving cetaceans or those that spend extended time at the surface are most vulnerable (Vanderlaan and Taggert 2007). However, ship strikes off the coast of southern California are infrequent (Berman-Kowaleski et al. 2010). There have been very few documented instances of a support vessel striking a pinniped in the POCS (MMS 2005), and no known ship strikes of marine mammals by support vessels serving the POCS platforms. Support vessel traffic under Alternative 1 would be temporary and associated with only a handful of platforms, and would occur along the same routes used by the supply ships that support current oil and gas production activities on the POCS. Although ship strikes are unlikely, because of the protected status of marine mammals, impacts from ship strikes under Alternative 1 activities would be moderate.

Under Alternative 2, potential impacts on marine mammals would be similar to those described for Alternative 1. However, Alternative 2 includes seasonal restrictions on impulsive conductor installation to minimize potential noise impacts when marine mammals may be present or most abundant.[21] For example, a summer closure period could minimize potential noise impacts on blue whales when they may be most abundant (but still uncommon) in the eastern Santa Barbara Channel and the San Pedro Basin lease areas (Table 2-3). Other species (e.g., humpback and Pacific gray whales) would be most abundant in the fall and winter. Thus, such seasonal closures

[21] Time-period restrictions have been employed to minimize impacts on marine mammals for activities such as seismic surveys, pile driving, and commercial fishing.

represent a tradeoff between different species, and no one closure period offers protection to all marine mammal species in the project area. Any reduction of overall impacts on marine mammals from seasonal restrictions under this alternative would thus likely be small due to the mentioned tradeoffs. Thus, potential impacts under Alternative 1 from impulsive conductor installation may be somewhat less for species most abundant during the conductor installation restriction period, but the same for all species during other times.

Under Alternative 3, potential impacts would be the same as those identified for Alternatives 1 and 2 (minor), except there would be no conductor installation and thus no associated impacts on marine mammals. Because there would be no conductor installation under Alternative 3, there would be less support vessel traffic and thus a reduced ship strike potential (although still a minor impact) than under Alternatives 1 and 2.

None of the potential impacts identified for Alternatives 1, 2, and 3 would occur under Alternatives 4 or 5, and any downhole operations authorized under Alternative 4 to ensure safety or pollution prevention would have negligible impacts on marine mammals. Previously permitted activities, supply vessel and helicopter traffic, and routine maintenance, inspection, and repair activities would continue and would have little to no effect on marine mammals, with the possible exception of potential strikes from ongoing supply ship traffic. As with the other alternatives, ship strikes are unlikely. Thus, overall impacts on marine mammals under Alternatives 4 and 5 would be negligible from all activities with a possible exception of unlikely but minor impacts should a ship strike occur.

4.3.8.1 Cumulative Impacts

Past and ongoing impacts on marine mammals on the POCS include those from oil and gas production; natural oil seeps; industrial, municipal, and agricultural runoff and discharges; marine debris; vessel and air traffic; non-native species; urban development; military testing and training activities; commercial and recreational fishing; commercial shipping; recreational boating, anthropogenic and natural toxins; unusual mortality events (UMEs), and increases in marine predators. For example, commercial fishing may accidentally entangle and drown or injure cetaceans (Northridge and Hoffman 1999, cited in NOAA 2014). Weather (e.g., storms and El Niño events) and climate change may also affect marine mammals. Impacts from these factors range from chronic and sporadic sublethal effects to mortality of individuals and possible population-level changes (Cassoff et al 2011; Halpern et al. 2009; Kaplan et al. 2010). Negligible to minor, incremental contributions from Alternative 1 would not result in cumulative impacts on marine mammal populations. The 2017 NFMS BA (BOEM and BSEE 2017b) identifies noise, ship strikes, and oil spills as potential impacting factors for seven ESA-listed whales potentially affected by ongoing oil and gas operations: blue whale, fin whale, humpback whale, north pacific right whale, sei whale, sperm whale, western gray whale, and from an oil spill for the listed Guadalupe fur seal (see Section 3.9). The BA made a determination of "not likely to adversely affect" for each of these species, noting little or no spatial overlap with ongoing operations.

4.3.9 Commercial and Recreational Fisheries

Under the Proposed Action, commercial and recreational fish species could be affected in the same manner as other marine species (see Sections 4.3.4 and 4.3.5). Pile driving noise and turbidity generated during conductor installation and during drilling waste disposal could temporarily displace fish and potentially disrupt fishing, but result in no more than minor localized and temporary impacts on nearby commercial and recreational fisheries. The additional vessel traffic that could be needed over a 5-year period to support conductor installation and drilling activities (Table 2-2) would follow routes routinely traveled by supply vessels currently servicing the platforms on a daily basis, and would cease after completion of conductor installation and drilling activities. Thus, support vessel traffic would not be expected to interfere with access to commercial or recreational fishing areas, and would have a negligible impact on commercial or recreational fishing activities in areas long accustomed to the presence of oil and gas activities.

Under Alternatives 2 and 3, potential impacts on commercial and recreational fishing would be similar to those described for Alternative 1. However, potential impacts associated with conductor installation (i.e., noise impacts during pile-driving) would not occur under Alternative 2 during periods when installation is restricted, and no conductor-related impacts would occur under Alternative 3. Overall impacts under both alternatives would be negligible.

Under Alternatives 4 and 5, none of the potential impacts identified for Alternatives 1, 2, and 3 would occur. Thus, overall impacts on commercial and recreational fishing from implementation of Alternatives 4 or 5 would be negligible.

4.3.9.1 Cumulative Impacts

Past, current, and anticipated future impacts on recreational and commercial fisheries on the POCS include the effects of overharvesting, vessel traffic, underwater construction activities, point-source and non-point-source discharges, and anthropogenic alteration of habitat (e.g., dredging or conversion of wetlands used by fishery species). The negligible incremental effects of Alternative 1 would not result in cumulative impacts on recreational and commercial fisheries.

4.3.10 Socioeconomics

None of the activities that could be permitted under Alternative 1 or 2 are expected to significantly affect employment, income, State and local tax revenues, population growth, housing, or community and social services. None of the activities that could be permitted would not require any significant increase in platform crew over current operations, and there would be no noticeable change in the workforce, routine supply vessel traffic, or helicopter traffic. Temporary and occasional increases in port activities associated with conductor installation or new drilling are expected to result in very localized and limited economic benefits for area businesses. Overall, the socioeconomic impacts of activities that could be permitted under Alternatives 1 or 2 would be negligible.

Under Alternative 3 there would be no noticeable change in the workforce, routine supply vessel traffic, or helicopter traffic supporting platform operations. Because no conductor installation

would occur with this alternative, any temporary increases in port activities would be associated primarily with new drilling, and any limited and temporary economic benefits for area businesses would be even less than under Alternatives 1 or 2. Overall, socioeconomic impacts of activities that could be permitted under Alternative 3 would be negligible.

Alternative 4 is not expected to result in any socioeconomic impacts on the local or regional economies in the short term, because currently permitted oil and gas production activities would continue. Oil and gas production on the POCS has been steadily declining as reserves become depleted, and would continue at a similar rate under Alternatives 1, 2 and 3. However, in the absence of new drilling and/or implementation of enhanced production activities as would occur under Alternative 4, oil and gas production may decline more rapidly than under any of the other action alternatives. Over time, this would result in a decline in POCS-related employment, income, and State and local tax revenues, and would result in minor socioeconomic impacts, although offshore oil and gas extraction is not a large component of the regional economy.

Impacts under Alternative 5, No Action, would be similar to those identified for Alternative 4. However, under Alternative 5 there would be no authorization of activities related to safe operations or pollution prevention, which would allow production to continue at wells where safety or pollution prevention concerns are identified. Instead, BSEE would enforce a shut-in of such wells by issuing an Incident of Noncompliance, and no further production would occur at the well. Thus, oil and gas production could decline more rapidly and result in a more rapid decline in employment, income, and State and local tax revenues than under Alternative 4. While such declines may occur more quickly under the No Action alternative, overall socioeconomic impacts would still be minor, because offshore oil and gas extraction is not a large component of the regional economy.

4.3.10.1 Cumulative Impacts

Because of Alternative 1 would have negligible socioeconomic impacts, there would be no cumulative socioeconomic impacts.

4.4 SUMMARY OF THE ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION AND ALTERNATIVES

Under the Proposed Action, the activities that could be approved and permitted have the potential to affect a variety of resources. The nature and magnitude of the potential impacts would be similar among Alternatives 1–3, except there would be no conductor installation–related impacts under Alternative 3. Impacts of these three alternatives are estimated to be negligible to minor, with the possible exception of potentially moderate impacts on marine mammals from conductor installation noise, and from collisions of sea turtles and marine mammals with supply ships. In contrast, none of the potential effects identified for the Proposed Action would be expected with Alternative 4, under which only temporary well abandonment or casing pressure repair would be authorized if deemed necessary for safety or pollution prevention. They also would not be expected with Alternative 5, No Action, under which there would be no further APD or APM approvals. Given the small number, limited locations, and temporary duration of the activities that are

reasonably foreseeable under Alternative 1, none of the alternatives would result in more than short-term, temporary, and localized minor impacts on the environment, with the possible exception of short-term, temporary, and localized moderate impacts on sea turtles and marine mammals from ship strikes (Table 4-9).

Oil and gas production on the POCS has been declining over the last 20 years, and is expected to continue to do so under each of the alternatives. Under Alternative 4, in the absence of new drilling and authorization of enhanced production activities, oil and gas production would decline more quickly than under any of the other action alternatives. As a consequence, overall employment, revenue, and State and local taxes may be expected to decline more rapidly than under Alternatives 1–3. Under Alternative 5, there would be no authorization of APMs, which could allow some wells (i.e., those with safety or pollution prevention concerns) to continue production. Rather, BSEE would enforce shut-in at such wells by issuing an Incident of Noncompliance, and production at the well would cease. Thus, Under Alternative 5, oil and gas production could decline more rapidly than under Alternative 4, and thus result in a more rapid decline in employment, income, and State and local tax revenues.

Given the temporary, short-term, and highly localized activities that could be permitted under the Proposed Action, the incremental contribution of impacts from the Proposed Action on area resources are not expected to result in significant cumulative impacts when added to past, current, and foreseeable future impacts on these resources.

Although an accidental hydrocarbon release during well drilling and subsequent production may also affect a variety of resources, all four alternatives have a similarly low potential for an accidental oil spill of a maximum likely size of 200 bbl (Section 4.2.2). An assumed 200-bbl maximum likely oil spill would cover a small area and last a short time, and would be further ameliorated by the resulting cleanup and response activities. Therefore, the exposure of resources to an accidental oil spill of this size occurring at one of the POCS production platforms would be very localized and temporary, and associated impacts would be negligible to minor. In addition, potential impacts on climate change from an anticipated small oil spill (200 bbl) would be negligible.

TABLE 4-9 Summary Comparison of Potential Effects Among Alternatives

Resource	Alternative 1—Proposed Action	Alternative 2—Time-Restricted Conductor Installation	Alternative 3—No Conductor Installation	Alternative 4—Approval of Permits Needed Only for Safety or Pollution Prevention	Alternative 5—No Action
Air Quality	Negligible to minor temporary and localized impacts from conductor installation, well drilling, and associated support ship and BSEE helicopter traffic. Emissions from ongoing oil and gas operations would continue, and overall emissions would decline as oil and gas production on the POCS continues to decline. Contributions to regional GHG levels would be negligible.	Similar to Alternative 1, except no conductor-related emissions during restricted installation times.	Similar but reduced emissions compared to Alternative 1, because no new conductor installation would occur.	None of the emissions (including GHG emissions) identified for Alternative 1 would occur. Emissions from ongoing operations would continue but may decline more rapidly as reserves decline and there is no authorization of new drilling or enhanced production activities.	Same as Alternative 4.
Acoustic Environment (Noise)	Minor temporary, short-term, and localized impacts from impulsive conductor installation and well drilling; negligible impacts from support ship and helicopter traffic. Noise would continue to be generated by ongoing operations, but overall levels would decline as production continues to decline.	Similar to Alternative 1, except no noise impacts related to conductor installation during restricted installation times.	Similar but reduced impacts from conductor-related noise compared to Alternative 1, because no new conductor installation would occur.	None of the impacts identified for Alternative 1 would occur. Noise from ongoing operations would continue to be generated but levels may decline more rapidly as reserves decline and there is no authorization of new drilling or enhanced production activities.	Same as Alternative 4.
Water Quality	Negligible to minor temporary, short-term, and localized impacts due to turbidity from conductor installation and from NPDES-permitted open-water discharge of drilling wastes.	Similar to Alternative 1, except no conductor-related impacts during restricted installation times.	Similar to but reduced impacts from turbidity compared to Alternative 1, because no new conductor installation would occur.	None of the impacts identified for Alternative 1. NPDES-permitted discharges from ongoing operations would continue, but overall level may decline as reservoirs decline and there is no authorization of new drilling or enhanced production activities.	Same as Alternative 4.

TABLE 4-9 (Cont.)

Resource	Alternative 1—Proposed Action	Alternative 2—Time-Restricted Conductor Installation	Alternative 3—No Conductor Installation	Alternative 4—No Conductor Installation or Well Drilling	
Marine/Coastal Invertebrates	Negligible to minor temporary, short-term, and localized impacts from turbidity during conductor installation and the discharge of drilling wastes. Negligible impacts from noise and ongoing permitted and routine operations.	Similar to Alternative 1, except no conductor-related impacts during restricted installation times.	Similar but reduced impacts from turbidity compared to Alternative 1, because no new conductor installation would occur.	None of the impacts identified for Alternative 1 would occur.	Same as Alternative 4.
Marine/Coastal Fish and Essential Fish Habitat	Minor temporary, short-term, and localized impacts from noise during impulsive conductor installation, and from turbidity during conductor installation and discharge of drilling wastes; negligible impacts from drilling noise and support vessel traffic.	Similar to Alternative 1, except no conductor-related noise and turbidity impacts during restricted installation times.	Similar but reduced impacts from noise compared to Alternative 1, because no new conductor installation would occur.	None of the impacts identified for Alternative 1 would occur.	Same as Alternative 4.
Sea Turtles	Negligible to minor temporary, short-term, and localized impacts from noise during impulsive conductor installation and drilling, and from turbidity during conductor installation and drilling waste discharge; and moderate but very unlikely impacts from vessel strikes along supply routes. A very low potential for strikes from vessels supporting ongoing oil and gas production would continue.	Similar to Alternative 1, except no conductor-related noise, turbidity, or vessel strike impacts during restricted installation times.	Similar to but reduced impacts from noise, turbidity, and ship strikes compared to Alternative 1, because no new conductor installation would occur.	None of the impacts identified for Alternative 1 would occur. A very low potential for strikes from vessels supporting ongoing production would continue, but may decline as production activities decline in the absence of new drilling or enhanced production activities.	Same as Alternative 4.

TABLE 4-9 (Cont.)

Resource	Alternative 1—Proposed Action	Alternative 2—Time-Restricted Conductor Installation	Alternative 3—No Conductor Installation	Alternative 4—No Conductor Installation or Well Drilling	
Marine and Coastal Birds	Negligible to minor temporary, short-term, and localized impacts from noise during impulsive conductor installation and drilling; negligible impacts from turbidity, additional platform lighting, and support vessel and helicopter traffic during conductor installation and drilling.	Similar to Alternative 1, except no conductor-related noise impacts during restricted installation times.	Similar to but reduced impacts from noise compared to Alternative 1, because no new conductor installation would occur.	None of the impacts identified for Alternative 1 would occur.	Same as Alternative 4.
Marine Mammals	Minor to moderate temporary, short-term, and localized impacts from noise during impulsive conductor installation. Negligible to minor temporary, short-term, and localized impacts from drilling noise and supply vessel and helicopter traffic; moderate impacts from vessel strikes along supply routes.	Similar to Alternative 1, except no conductor-related noise impacts during restricted installation times when sensitive species may be present.	No impacts from impulsive conductor installation and similar but reduced impacts from vessel traffic compared to Alternative 1, because no new conductor installation would occur.	None of the impacts identified for Alternative 1 would occur. The very low potential for strikes from vessels supporting ongoing production would continue, but may be expected to be even lower as production activities decline in the absence of new drilling or enhanced production activities.	Same as Alternative 4.
Commercial and Recreational Fisheries	Negligible to minor temporary, short-term, and localized impacts from noise and turbidity during conductor installation and drilling waste discharge; negligible impacts from space use conflicts with support vessel traffic.	Similar to Alternative 1, except no conductor-related noise impacts during restricted installation times.	Similar but reduced noise impacts compared to Alternative 1, as no new conductor installation would occur.	None of the impacts identified for Alternative 1 would occur.	Same as Alternative 4.

TABLE 4-9 (Cont.)

Resource	Alternative 1—Proposed Action	Alternative 2—Time-Restricted Conductor Installation	Alternative 3—No Conductor Installation	Alternative 4—No Conductor Installation or Well Drilling	
Socioeconomics	Negligible impacts from temporary, short-term, and localized increases in work force and materials during conductor installation and drilling. Due to continued expected decline in production, overall levels of employment, income, and local and state revenues will likely slowly decline.	Same as Alternative 1.	Similar to Alternative 1.	In the absence of authorizing permits for new drilling or enhanced production activities, oil and gas production is expected to decline more rapidly than under Alternative 1. As a result, minor impacts may occur as local employment, income, and state and local tax revenues decline more rapidly than under Alternative 1.	Similar to Alternative 4, except employment, income, and tax revenues may decline more rapidly as BSEE enforces shut-in of wells posing safety or pollution prevention concerns rather than permitting downhole operations to ensure safe operations or pollution prevention and continued production.

5 LIST OF PREPARERS

Table 5-1 presents information on the preparers of the *Draft Programmatic Environmental Assessment of Federally Regulated Offshore Oil and Gas Activities in the Southern California Planning Area*. The list of preparers is organized by agency or organization, and information is provided on their contribution to the Environmental Assessment.

TABLE 5-1 List of Preparers

Name	Education/Experience	Contribution
Bureau of Environmental Safety and Enforcement		
David Fish	B.A. International Relations, M.A. Public Policy; BSEE Senior Advisor and Chief, Environmental Compliance Division; 32 years of experience in safety and environmental preparedness, response, and enforcement including Federal On-Scene Coordinator for the U.S. Coast Guard and BSEE.	BSEE Project Manager; subject matter expert; technical expertise, support, and review.
Glenn Degnitz	B.S Environmental Studies, M.S. Environmental Policy and Management; Level II Certified Contract Manager; 20 years of experience in contract support and environmental management and protection.	Project management support; subject matter expert coordination.
Jordan Creed	B.S. Marine Biologist, M.S. Marine Science; BSEE Environmental Protection Specialist; 5 years of experience in environmental compliance, preparedness, and response in multiple disciplines.	NEPA subject matter expert; technical expertise, project management support, and review.
Mark Fesmire	B.S. Geological Engineering, B.S. Civil Engineering, Juris Doctorate; Regional Director, BSEE Alaska Outer Continental Shelf Region and Acting Regional Director, Pacific Outer Continental Shelf Region; licensed attorney and petroleum engineer; 40 years of experience as a petroleum engineer, Professor of Law, and Natural Resources Regulator at the Bureau Chief, Director, and Commissioner levels.	Subject matter expert, technical expertise, support, and review.
Rance Wall	B.S. Civil Engineering, M.E. Petroleum Engineering; Deputy Regional Director for BSEE Pacific Region; 40 years of experience in civil and petroleum engineering positions with the Federal Government and private industry.	Subject matter expert, technical expertise, support, and review.

TABLE 5-1 (Cont.)

Name	Education/Experience	Contribution
James Salmons	B.S. Aeronautics, M.B.A. Human Resources Management and Organizational Development, M.Sc. Environmental Science and Policy, Juris Doctorate Candidate; 9 years of experience in environmental and social impact analyses.	Subject matter expert, technical expertise, support, and review.
Monica Chacon	B.A. International Relations; BSEE Program Manager, Environmental Compliance Division; 10 years of environmental experience in addition to 13 years Federal oil and gas management.	Project management support and review.
Bureau of Ocean Energy Management		
Richard Yarde	B.S. Wildlife Science, M.S. Renewable Natural Resource Studies, J.D.; 20 years of experience in environmental analysis and policy; BOEM Pacific Regional Supervisor, Office of Environment.	BOEM Project Manager; general document and process support.
David Panzer	B.S. Oceanography, B.A. Zoology; BOEM Chief, Environmental Analysis Section, Pacific Region; more than 30 years of experience in environmental assessment and EPA.	NEPA; technical expertise, support, and review.
Argonne National Laboratory		
Ihor Hlohowskyj	Ph.D. Zoology; 39 years of experience in ecological research; 37 years in environmental assessment.	Argonne Project Manager; purpose and need, proposed action and alternatives, review.
Kurt Picel	Ph.D. Environmental Health Sciences; 38 years of experience in environmental health analysis; 20 years in environmental assessment.	Assistant Project Manager; proposed action and alternatives; water quality, review.
Young Soo Chang	Ph.D. Chemical Engineering; 26 years of experience in air quality and noise impact analysis.	Air quality.
Mark Grippo	Ph.D. Biology; 11 years of experience in aquatic resource studies and impact analysis.	Benthic resources; marine and coastal fish; essential fish habitat.
John Hayse	Ph.D. Zoology; 29 years of experience in ecological research and environmental assessment.	Recreational and commercial fisheries.

TABLE 5-1 (Cont.)

Name	Education/Experience	Contribution
Pamela Richmond	M.S. Computer Information Systems; 19 years of experience in Website development and related technology.	Public website.
Carolyn Steele	B.S. English, B.S. Rhetoric; 12 years of experience in technical editing.	Lead technical editor.
Katherine Obmascik	B.A. Journalism, M.B.A. Marketing Communications; 35 years of experience in technical writing and editing.	Technical editor.
William Vinikour	M.S. Biology with environmental emphasis; 40 years of experience in ecological research and environmental assessment	Marine mammals, marine and coastal birds, sea turtles, listed species, socioeconomics, environmental justice, cumulative impacts.
Emily Zvolanek	B.A. Environmental Science; 8 years of experience in GIS mapping.	Technical lead for GIS mapping and analysis.
Robert Van Lonkhuyzen	B.A. Biology; 28 years of experience in ecological research and environmental assessment.	Socioeconomics, recreation and tourism, areas of concern, environmental justice.
Barbara Simmons	B.A. Technical Writing; 45 years of experience in publications management and technical editing.	Technical editor.

1

APPENDIX A:

REFERENCES

Allen, M.J., et al., 2011, *Southern California Bight 2008 Regional Monitoring Program: Volume IV. Demersal Fishes and Megabenthic Invertebrates, Southern California Coastal Water Research Project*, Costa Mesa, CA.

Andrew, R.K., B.M. Howe, J.A. Mercer, and M.A. Dzieciuch, 2002, "Ocean Ambient Sound: Comparing the 1960s with the 1990s for a Receiver off the California Coast," *Acoustics Research Letters Online* 3(2):65–70.

Arata, L., and M. Pritkin, 2009, *Pocket Guide to Beach Birds of California*, PRBO Conservation Science, Petaluma, CA. Available at http://www.pointblue.org/pocketguides/beach. Accessed Aug. 11, 2015.

ARB (Air Resources Board), 2017a, "California Ambient Air Quality Standards (CAAQS)," California Environmental Protection Agency. Available at http://www.arb.ca.gov/research/aaqs/caaqs/caaqs.htm. Accessed April 5, 2017.

ARB, 2017b, "State Standard Area Designations," California Environmental Protection Agency. Available at http://www.arb.ca.gov/desig/statedesig.htm. Accessed April 5, 2017.

ARB, 2017c, "Emission Inventory Data: 2012 Base Year Emissions," California Environmental Protection Agency. Available at http://www.arb.ca.gov/ei/emissiondata.htm. Accessed May 8, 2017.

ARB, 2017d, "California Greenhouse Gas Emission Inventory - 2016 Edition," California Environmental Protection Agency. Available at http://www.arb.ca.gov/cc/inventory/data/data.htm. Accessed May 8, 2017.

Battelle, 1991, *California OCS Phase II Monitoring Program. Final Report*, submitted to the U.S. Department of the Interior, Minerals Management Service.

Bearzi, M., and C.A. Saylan, 2011, "Cetacean Ecology for Santa Monica Bay and Nearby Areas, California, in the Context of the Newly Established MPAs," *Bulletin of the Southern California Academy of Sciences* 110(2):35–51.

Bemis, B.E., R.B. Spies, D.D. Hardin, and J.A. Johnson, 2014, *Determining the Potential Release of Contaminants into the Marine Environment from Pacific OCS Shell Mounds, OCS Study BOEM 2013-208*, prepared by Applied Marine Sciences, Inc., for U.S. Department of the Interior, Bureau of Ocean Energy Management, Camarillo, CA.

Beranek, L.L., and I.L. Ver, 1992, *Noise and Vibration Control Engineering: Principles and Applications*, John Wiley & Sons, Inc., NY.

Bergen M., S.B. Weisberg, R.W. Smith, D.B. Cadien, A. Dalkey, D.E. Montagne, J.K. Stull, R.G. Velarde, and J.A. Ranasinghe, 2001, "Relationship between Depth, Sediment, Latitude, and the Structure of Benthic Infaunal Assemblages on the Mainland Shelf of Southern California," *Marine Biology* 138:637–647

Berman-Kowalewski, M., et al., 2010, "Association Between Blue Whale (Balaenoptera musculus) Mortality and Ship Strikes Along the California Coast," *Aquatic Mammals* 36(1):59–66.

Blake, J.A., and A. Lissner, 1993, "Volume 1. Introduction, Benthic Ecology, Oceanography, Platyhelminthes, and Nemertea," in *Taxonomic Atlas of the Santa Maria Basin and Western Santa Barbara Channel*, Oct. Available at https://invertebrates.si.edu/boem/reports/CAMP_Taxa1.pdf. Accessed Aug. 9, 2017.

Blanchette, C.A., and S.D. Gaines, 2007, "Distribution, Abundance, Size and Recruitment of the Mussel, Mytilus californianus, across a Major Oceanographic and Biogeographic Boundary at Point Conception, California, USA," *Journal of Experimental Marine Biology and Ecology* 340:268–279.

Blanchette, C.A., P.T. Raimondi, R. Gaddam, J. Burnaford, J. Smith, D.M. Hubbard, J.E. Dugan, J. Altstatt, and J. Bursek, 2015, *South Coast Baseline Program Final Report: Rocky Intertidal Ecosystems*, Jan. 30. Available at https://caseagrant.ucsd.edu/sites/default/files/SCMPA-22-Final-Report_0.pdf. Accessed June 14, 2018.

BOEM (Bureau of Ocean Energy Management), 2012, *Gulf of Mexico OCS Oil and Gas Lease Sales: 2012–2017; Western Planning Area Lease Sales 229, 233, 238, 246, and 248; Central Planning Area Lease Sales 227, 231, 235, 241, and 247. Final Environmental Impact Statement*, OCS EIS/EA BOEM 2012-019, Gulf of Mexico OCS Region, New Orleans, LA, July.

BOEM, 2014a, *2011 National Assessment of Oil and Gas Resources: Assessment of the Pacific Outer Continental Shelf Region*, OCS Report BOEM 2014-667, K.A. Piper and C.O. Ojukwa (eds.).

BOEM, 2014b, *Environmental Assessment: Platform Harmony Conductor Installation ExxonMobil Production Company Santa Ynez Unit Offshore Santa Barbara County, California*, Pacific OCS Region, Camarillo, CA.

BOEM, 2014c, *Gulf of Mexico OCS Oil and Gas Lease Sales: 2015–2017 Central Planning Area Lease Sales 235, 241, and 247 Final Supplemental Environmental Impact Statement*, OCS EIS/EA BOEM 2014-655, Gulf of Mexico OCS Region, New Orleans, LA, Sept.

BOEM, 2016, *Gulf of Mexico OCS Oil and Gas Lease Sale: 2017 Central Planning Area Lease SALE 247 Draft Supplemental Environmental Impact Statement*, OCS EIS/EA BOEM 2016-006, Gulf of Mexico OCS Region, New Orleans, LA, Feb.

BOEM and BSEE, 2017a, *Offshore Oil and Gas Development and Production Activities in the Southern California Planning Area: Biological Assessment U.S. Fish and Wildlife Service*

Regulated Endangered and Threatened Species, prepared for the U.S. Fish and Wildlife Service, March.

BOEM and BSEE, 2017b, *Offshore Oil and Gas Development and Production Activities in the Southern California Planning Area: Biological Assessment Endangered and Threatened Species*, prepared for the National Marine Fisheries Service, March.

BOEMRE (Bureau of Ocean Energy, Management, Regulation, and Enforcement), 2011, *Commercial Wind Lease Issuance and Site Characterization Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia, Draft Environmental Assessment*, OCS EIS/EA BOEMRE 2011-037, Office of Offshore Alternative Energy Programs, July. Available at https://www.boem.gov/uploadedFiles/BOEM/Renewable_Energy_Program/Smart_from_the_Start/MidAtlanticWEAs_DraftEA.pdf. Accessed May 12, 2017.

BSEE (Bureau of Safety and Environmental Enforcement), 2011, *Environmental Assessment Platforms A, B and Hillhouse Pipeline Replacement Project*, Pacific OCS Region, Camarillo, CA, Nov. 29.

BSEE, 2016, *POCSR Production and Development Statistics*, Jan.

BSEE and BOEM, 2016, *Programmatic Environmental Assessment of the Use of Well Stimulation Treatments on the Pacific Outer Continental Shelf*, Pacific OCS Regions, Camarillo, CA. Available at pocswellstim.evs.anl.gov.

Calambokidis, J., G.H. Steiger, C. Curtice, J. Harrison, M.C. Ferguson, E. Becker, M. DeAngelis, and S.M. Van Parijs, 2015, "Biologically Important Areas for Selected Cetaceans Within U.S. Waters – West Coast Region," *Aquatic Mammals* 41(1):39–53.

California Herps, 2017, "California Turtles." Available at http://www.californiaherps.com/turtles/turtles.html. Accessed May 10, 2017.

Campbell, G., L. Roche, K. Whitaker, E. Vu, and J. Hildebrand, 2014, *Marine Mammal Monitoring on California Cooperative Oceanic Fisheries Investigation (CALCOFI) Cruises: 2012–2013*, MPL TM-549, Marine Physical Laboratory of the Scripps Institution of Oceanography, San Diego, CA, Feb. Available at http://cetus.ucsd.edu/Publications/Reports/CampbellMPLTM549-2014.pdf. Accessed May 26, 2015.

Campbell, G.S., L. Thomas, K. Whitaker, A.B. Douglas, J. Calambokidis, and J.A. Hildebrand, 2015, "Inter-Annual and Seasonal Trends in Cetacean Distribution, Density and Abundance off Southern California," *Deep-Sea Research II: Topical Studies in Oceanography* 112:143–157.

Carretta, J.V., et al., 2016a, *U.S. Pacific Marine Mammal Stock Assessments: 2015*, NOAA-TM-NMFS-SWFSC-561, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, May. Available at http://www.nmfs.noaa.gov/pr/sars/pdf/pacific2015_final.pdf. Accessed April 15, 2017.

Carretta, J.V., et al., 2016b, *U.S. Pacific Draft Marine Mammal Stock Assessments: 2016*, NOAA-TM-NMFS-SWFSC-XXX, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center. Available at http://www.nmfs.noaa.gov/pr/sars/pdf/pac2016_draft.pdf. Accessed April 15, 2017.

Casper, B.M., T.J. Carlson, M.G. Halvorsen, and A.N. Popper, 2016, "Effects of impulsive pile driving exposures on fishes." Chapter 15 in A.N. Popper and A. Hawkins (eds.) *The Effects of Noise on Aquatic Life II.*

Cassoff, R.M., K.M. Moore, W.A. McLellan, S.G. Barco, D.S. Rotsteins, and M.J. Moore, 2011, "Lethal Entanglement in Baleen Whales," *Diseases of Aquatic Organisms* 96:175–185.

CDFW (California Department of Fish and Wildlife), 2004, *Annual Status of the Fisheries Report through 2003*, prepared for the Fish and Game Commission, Dec. Available at https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=34389&inline=true. Accessed May 18, 2017.

CDFW, 2014b, "Review of Selected California Fisheries for 2013: Coastal Pelagic Finfish, Market Squid, Groundfish, Highly Migratory Species, Dungeness Crab, Basses, Surfperch, Abalone, Kelp and Edible Algae, and Marine Aquaculture," *Fisheries Review CalCOFI Report* 55:11–50. Available at http://calcofi.org/publications/calcofireports/v55/Vol_55_FisheriesReview.pdf. Accessed May 17, 2017.

Claisse, J.T., D.J. Pondella II, M. Love, L.A. Zahn, C.M. Williams, J.P. Williams, and A.S. Bull, 2014, "Oil Platforms off California Are among the Most Productive Marine Fish Habitats Globally," *Proceedings of the National Academy of Science* 111:15462–15467.

CMLPAI (California Marine Life Protection Act Initiative), 2009, Regional Profile of the MLPA South Coast Study Region (Point Conception to the California-Mexico Border), California Department of Fish and Wildlife, Monterey, CA, June 25. Available at http://www.dfg.ca.gov/marine/mps/regionalprofile)sc.asp. Accessed May 26, 2015.

Collins, P.W., 2011, *Channel Islands Bird Checklist*, U.S. Department of the Interior, National Park Service, Channel Islands National Park. Available at http://www.nps.gov/chis/learn/nature/upload/bird-list-all-final.pdf. Accessed Aug. 11, 2015.

CSA (Continental Shelf Associates), 2005, *Survey of Invertebrate and Algal Communities on Offshore Oil and Gas Platforms in Southern California, Final Report*, OCS Study MMS 2005-070, prepared for the U.S. Department of the Interior, Minerals Management Service, Pacific Outer Continental Shelf Region, Camarillo, CA, Dec.

CSA Ocean Sciences Inc., 2014, *Quieting Technologies for Reducing Noise during Seismic Surveying and Pile Driving Workshop, Summary Report*, BOEM 2014-061, prepared for U.S. Department of the Interior, Bureau of Ocean Management, March.

Dailey, D., J. Reish, and D.W. Anderson, 1993, *Ecology of the Southern California Bight: A Synthesis and Interpretation*, University of California Press, Los Angeles, CA.

Debich, A.J., B. Thayre, and J.A. Hildebrand, 2017, *Marine Mammal Monitoring on California Cooperative Oceanic Fisheries Investigation (CALCOFI) Cruises: Summary of Results 2012–2016*, MPL Technical Memorandum 609, Marine Physical Laboratory, Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA, Feb.

Diener, and Lissner, 1995, "Hard bottom fauna," in M. Steinhaoure and E. Imamura (eds), *California OCS Phase II Monitoring Program, Year-Three Annual Report*, OCS Study MMS 90-0055, U.S. Department of the Interior, Minerals Management Service.

DieselNet, 2017, "Nonroad diesel engines." Available at https://www.dieselnet.com/standards/us/nonroad.php#intro. Accessed Aug. 28, 2017.

Douglas, A.B., J. Calambokidis, L.M. Munger, M.S. Soldevilla, M.C. Ferguson, A.M. Havron, D.L. Camacho, G.S. Campbell, and J.A. Hildebrand, 2014, "Seasonal Distribution and Abundance of Cetaceans off Southern California Estimated from CalCOFI Cruise Data from 2004 to 2008," *Fisheries Bulletin* 112:197–220.

Duncan, A.J., and R.D. McCauley, 2008, "Environmental Impact Assessment of Underwater Sound: Progress and Pitfalls," in *Proceedings of Acoustics 2008*, Nov. 24–26, 2008, Geelong, Victoria, Australia. Available at https://www.acpustics.asn.au/conference-proceedings/AAS2008/papers/pb.pdf. Accessed July 7, 2017.

eBird, 2017, "Species Maps." Available at http://ebird.org/ebird/map. Accessed April 14, 2017.

Edmonds N.J., C.J. Firmin, D. Goldsmith, R.C. Faulkner, and D.T. Wood, 2016, "A review of crustacean sensitivity to high amplitude underwater noise: Data needs for effective risk assessment in relation to UK commercial species," *Marine Pollution Bulletin* 108:5–11.

EIA (U.S. Energy Information Administration), 2017a, "Frequently Asked Questions: How Much Oil is Consumed in the United States," U.S. Department of Energy, Washington, DC. Available at https://www.eia.gov/tools/faqs/#crudeoil. Accessed April 17, 2017.

EIA, 2017b, Natural Gas, "U.S. Natural Gas Total Consumption," U.S. Department of Energy, Washington, DC. Available at https://www.eia.gov/dnav/ng/hist/n9140us2m.htm. Accessed April 17, 2017.

EIA, 2017c, "Petroleum Products Made from a Barrel of Crude Oil, 2016." Available at https://www.eia.gov/energyexplained/index.cfm?page=oil_home. Updated May 5, 2017.

EPA (U.S. Environmental Protection Agency), 2013a, *Authorization to Discharge Under the National Pollutant Discharge Elimination System for Oil and Gas Exploration, Development, and Production Facilities, General Permit* No. CAG280000, Dec. 20.

EPA, 2013b, *Final NPDES Permit No. CAG280000 for Offshore Oil and Gas Exploration, Development and Production Operations off Southern California*, Addendum to Fact Sheet.

EPA, 2014, "Emission Factors for GHG Inventories." Available at https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf. Accessed Aug. 23, 2017.

EPA, 2017a, "NAAQS Table." Available at https://www.epa.gov/criteria-air-pollutants/naaqs-table%20, last updated Dec. 20, 2016. Accessed April 5, 2017.

EPA, 2017b, *Nonattainment Areas for Criteria Pollutants (Green Book).* Available at http://www.epa.gov/green-book. Accessed April 5, 2017.

EPA, 2017c, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2015*, EPA 430-P-17-001. Available at https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2015. Accessed May 8, 2015.

Erbe, C., C. Reichmuth, K. Cunningham, K. Lucke, and R. Dooling, 2016, "Communication Masking in Marine Mammals: A Review and Research Strategy," *Marine Pollution Bulletin* 103:15–38.

Farwell, C., C.M. Reddy, E. Peacock, R.K. Nelson, L. Washburn, and D.L. Valentine, 2009, "Weathering and the Fallout Plume of Heavy Oil from Strong Petroleum Seeps Near Coal Oil Point, CA," *Environ. Sci. Technol.* 4:3542–3548.

Gales, R.S., 1982, *Effects of Noise of Offshore Oil and Gas Operations on Marine Mammals, An Introductory Assessment*, Technical Report 844 Volumes I and II, prepared by the Naval Ocean Systems Center, San Diego, CA, for the U.S. Department of the Interior, Bureau of Land Management, Sept.

Gillette, D.J., L.L. Lovell and K.C. Schiff, 2017, *Southern California Bight 2013 Regional Monitoring Program: Volume VI. Benthic Infauna*, Technical Report 971, Southern California Coastal Water Research Project, Costa Mesa, CA.

Good, T.P., R.S. Waples, and P. Adams (eds.), 2005, *Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead*, Technical Memorandum NMFS-NWFSC-66, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, June.

Greene, C.R., Jr., 1995, "Ambient Noise," Chapter 5 in *Marine Mammals and Noise*, Richardson et al. (eds.), Academic Press, San Diego, CA.

Greene, C.R., Jr., and S.E. Moore, 1995, "Man-Made Noise," Chapter 6 in *Marine Mammals and Noise*, Richardson et al. (eds.), Academic Press, San Diego, CA.

Halpern, B.S., C.V. Kappel, K.A. Selkoe, F. Micheli, C.M. Ebert, C. Kontgis, C.M. Crain, R.G. Martone, C. Shearer, and S.J. Teck, 2009, "Mapping Cumulative Human Impacts to California Current Marine Ecosystems," *Conservation Letters* 2:138–148.

Hawkins, A.D., and A.N. Popper, 2017, "A sound approach to assessing the impact of underwater noise on marine fishes and invertebrates," *ICES Journal of Marine Science* 74:635–651.

Hornafius, J.S., D. Quigley, and B.P. Luyendyk, 1999, "The World's Most Spectacular Marine Hydrocarbon Seeps (Coal Oil Point, Santa Barbara Channel, California): Quantification of Emissions," *Journal of Geophysical Research* 104(C9):20,703–20,711.

Hostettler, F.D., R.J. Rosenbauer, T.D. Lorenson, and J. Dougherty, 2004, "Geochemical Characterization of Tarballs on Beaches along the California Coast. Part I—Shallow Seepage Impacting the Santa Barbara Channel Islands, Santa Cruz, Santa Rosa and San Miguel," *Organic Geochemistry* 35:725–746.

Houseworth, J., and W. Stringfellow, 2015, "A Case Study of California Offshore Petroleum Production, Well Stimulation, and Associated Environmental Impacts," Chapter 2 in *An Independent Scientific Assessment of Well Stimulation in California, Volume III*, California Council on Science and Technology.

Howard, M.D.A., et al., 2012, "Water Quality," in *Southern California Bight 2008 Regional Monitoring Program: Volume VII*, Technical Report 710, Southern California Coastal Water Research Project, Costa Mesa, CA.

Howard M.D.A., et al., 2014, "Anthropogenic Nutrient Sources Rival Natural Sources on Small Scales in the Coastal Waters of the Southern California Bight," *Limnology and Oceanography* 59.

Howorth, P., 2014, *Marine Mammal Mitigation Report, ExxonMobil Well Conductor Installation Project at Platform Harmony, Gaviota, California*, prepared by Marine Mammal Consulting Group, Santa Barbara, CA, for ExxonMobil Production Company, Houston, TX, Jan.

Hyland, J., E. Baptiste, J. Kennedy, J. Campbell, R. Kropp, C. Robinson, and S. Williams, 1990, Chapter 7, "Macroinfaunal Assemblages in the Santa Maria Basin off the Coast of Southern California," in *California OCS Phase II Monitoring Program, Year-three Annual Report*, OCS Study MMS 90-0055, M. Steinhauer and E. Imamura (eds.), U.S. Department of the Interior, Minerals Management Service.

Iafrate, J.D., S.L. Watwood, E.A. Reyier, D.M. Scheidt, G.A. Dossot, and S.E. Crocker, 2016, "Effects of Pile Driving on the Residency and Movement of Tagged Reef Fish," *PLoS ONE* 11(11):e0163638. doi:10.1371/journal.pone.0163638.

Jefferson, T.A., et al., 2014a, "Southern California Bight Marine Mammal Density and Abundance from Aerial Surveys, 2008-2013," *Journal of Marine Animals and Their Ecology* 7(2):14–30.

Jefferson, T.A., et al., 2014b, "Global Distribution of Risso's Dolphin *Grampus griseus*: A Review and Critical Evaluation," *Mammal Review* 44:56–68.

Johnson, J.A., J. Storrer, K. Fahy, and B. Reitherman, 2011, *Determining the Potential Effects of Artificial Lighting from Pacific Outer Continental Shelf (POCS) Region Oil and Gas Facilities on Migrating Birds*, OCS Study BOEMRE 2011-047, prepared by Applied Marine Sciences, Inc., and Storrer Environmental Services for U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulations and Enforcement, Camarillo, CA, Sept.

Kaplan, B., C.J. Beegle-Krause, D. French McCay, A. Copping, and S. Geerlofs (eds.), 2010, *Updated Summary of Knowledge: Selected Areas of the Pacific Coast*, OCS Study BOEMRE 2010-014, U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific Outer Continental Shelf Region, Camarillo, CA.

Kastelein, R.A., R. Gransier, M.A.T. Marijt, and L. Hoek, 2015, "Hearing Frequency Thresholds of Harbor Porpoises (*Phocoena phocoena*) Temporarily Affected by Played Back Offshore Pile Driving Sounds," *Journal of the Acoustical Society of America* 137(2):556–564.

Kim, J., 2014, "Rare Marine Life Visited Southern California in Record Numbers in 2014." Available at http://www.scpr.org/news/2015/01/05/49034/rare-marine-life-visited-southern-california-in-re/. Accessed March 28, 2017.

Lehman, P.E., 2014, *The Birds of Santa Barbara County, California (Revised),* Vertebrate Museum, University of California, Santa Barbara, CA.

Lissner A.L., G.L. Taghon, D.R. Diener, and S.C. Schroeter, 1987, *Review of Recovery and Recolonization of Hard Substrate Communities of the Outer Continental Shelf*, MMS OCS Study 88-0034.

Love, M.S., and A. York, 2005, "A Comparison of the Fish Assemblages Associated with an Oil/Gas Pipeline and Adjacent Seafloor in the Santa Barbara Channel, Southern California Bight," *Bulletin of Marine Science* 77:101–117.

Lyon, G.S., and E.D. Stein, 2009, "How effective has the Clean Water Act been at reducing pollutant mass emissions to the Southern California Bight over the past 35 years?" *Environmental Monitoring and Assessment* 154:413–426.

Lyon, G.S., and E.D. Stein, 2010, "Effluent Discharges from Offshore Oil Platforms to the Outer Continental Shelf of Southern California in 2005," pp. 29–43 in *Southern California Coastal Water Research Project 2010 Annual Report*, S.B. Weisberg and K. Miller (eds.), Southern California Coastal Water Research Project, Costa Mesa, CA. Available at http://ftp.sccwrp.org/pub/download/DOCUMENTS/AnnualReports/2010AnnualReport/ar10_029_043.pdf. Accessed June 24, 2015.

MacGillivray, A., and A. Schlesinger, 2015, *Harmony Platform 2014 Conductor Driving Acoustic Monitoring: Final Report*, JASCO Document 00964, Version 3.0, prepared by JASCO Applied Sciences Ltd. for ExxonMobil Production Company.

Marantz, C., 1986, *The Birds of San Luis Obispo, California: Their Status and Distribution*, California Polytechnic State University, School of Science and Mathematics, Biological Sciences Department, San Luis Obispo, CA.

Mason, J.W., et al., 2007, "At-Sea Distribution and Abundance of Seabirds off Southern California: A 20-Year Comparison," *Studies in Avian Biology*, No. 33.

Maxon Consulting, Inc., 2015, *Harmony Platform Acoustic Monitoring: Installation of Conductor No. 2.*, prepared by Maxon Consulting, Inc., for ExxonMobil Production Company San Diego, CA.

McDonald, M.A., J.A. Hildebrand, and S.M. Wiggins, 2006, "Increases in Deep Ocean Ambient Noise in the Northeast Pacific West of San Nicolas Island, California," *Journal of the Acoustical Society of America* 120(2):711–718.

McDonald, M.A., J.A. Hildebrand, S.M. Wiggins, and D. Ross, 2008, "A 50-Year Comparison of Ambient Ocean Noise near San Clemente Island: A Bathymetrically Complex Coastal Region off Southern California," *Journal of the Acoustical Society of America* 124(4):1985–1992.

Miller, E.F., and K. Schiff, 2012, "Descriptive Trends in Southern California Bight Demersal Fish Assemblages, 1994–2008," CalCOFI Rep., Vol. 53.

MMS (Minerals Management Service), 2001, *Delineation Drilling Activities in Federal Waters Offshore Santa Barbara County, California Draft Environmental Impact Statement*, MMS 2001-046, U.S. Department of the Interior, Mineral Management Service, Pacific Outer Continental Shelf Region.

MMS, 2005, *Environmental Information Document for Post-Suspension Activities on the Nine Federal Undeveloped Units and Lease OCS-P 0409: Offshore Santa Barbara, Ventura, and San Luis Obispo Counties*, prepared by the Aspen Environmental Group, Jan.

MMS, 2009, *Environmental Assessment, ExxonMobil Production Company's Santa Ynez Unit C1 Cable Repair*, Pacific OCS Region. Available at www.boem.gov/Environmental-Assessments-Pacific-Region.

Muto, M.M., et al., 2016a, *Alaska Marine Mammal Stock Assessments, 2015*, NOAA Technical Memorandum NMFS-AFSC-323, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, June. Available at http://www.nmfs.noaa.gov/pr/sars/pdf/alaska2015_final_corrected_.pdf. Accessed April 15, 2017.

Muto, M.M., et al., 2016b, *Alaska Marine Mammal Stock Assessments: 2016*, Alaska Fisheries Science Center, Seattle, Marine Mammal Laboratory, WA. Available at http://www.nmfs.noaa.gov/pr/sars/pdf/ak2016_draft.pdf. Accessed April 15, 2017.

NCE (Noise Control Engineering), 2007, *Review of Existing and Future Potential Treatments for Reducing Underwater Sound from Oil and Gas Industry Activities*, NCE Report 07-001, prepared by Noise Control Engineering, Inc., Dec. 31.

Neuman, M., B. Tissot, and G. Vanblaricom, 2010, "Overall Status and Threats Assessment of Black Abalone (Haliotis Cracherodii Leach, 1814) Populations in California," *Journal of Shellfish Research* 29:577–586.

NMFS (National Marine Fisheries Service), 2008a, *Final White Abalone Recovery Plan (*Haliotis sorenseni*)*, prepared by White Abalone Recovery Team for National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources. Available at http://www.nmfs.noaa.gov/pr/pdfs/recovery/whiteabalone.pdf. Accessed May 17, 2015.

NMFS, 2008b, "Endangered and Threatened Species; Endangered Status for North Pacific and North Atlantic Right Whales," *Federal Register* 73(45):12024–12030.

NMFS, 2012, "Endangered and Threatened Species: Final Rule to Revise the Critical Habitat Designation for the Endangered Leatherback Sea Turtle," *Federal Register* 77(17):4170–4201.

NMFS, 2014a, *Issuance of an Incidental Harassment Authorization to ExxonMobil Production Company to Take Marine Mammals by Harassment Incidental to Conductor Pipe Installation Activities at Harmony Platform in the Santa Barbara Channel Offshore of California*, Office of Protected Resources, Permits and Conservation Division, Silver Springs, MD.

NMFS, 2014b, "Threats to Sea Turtles." Updated June 16. Available at http://www.nmfs.noaa.gov/pr/species/turtles/threats.html. Accessed March 24, 2017.

NMFS, 2014c, "Hawksbill Turtle (Eretmochelys imbricata). Updated Oct. 30. Available at http://www.fisheries.noaa.gov/pr/species/turtles/hawksbill.html. Accessed March 24, 2017.

NMFS, 2014d, "Olive Ridley Turtle (*Lepidochelys olivacea*)." Updated Oct. 30. Available at http://www.fisheries.noaa.gov/pr/species/turtles/oliveridley.htm. Accessed May 11, 2015.

NMFS, 2015a, "Northern Fur Seal (*Callorhinus ursinus*)." Updated Jan. 2. Available at http://www.fisheries.noaa.gov/pr/species/mammals/seals/northern-fur-seal.html. Accessed May 11, 2015.

NMFS, 2015b, "Fin Whale (*Balaenoptera physalus*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/fin-whale.html. Accessed May 26, 2015.

NMFS, 2015c, "Gray Whale (*Eschrichtius robustus*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/gray-whale.html. Accessed May 26, 2015.

NMFS, 2015d, "Minke Whale (*Balaenoptera acutorostrata*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/whales/minke-whale.html. Accessed May 11, 2015.

NMFS, 2015e, "North Pacific Right Whale (*Eubalaena japonica*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/north-pacific-right-whale.html. Accessed May 26, 2015.

NMFS, 2015f, "Sei Whale (*Balaenoptera borealis*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/sei-whale.html. Accessed May 11, 2015.

NMFS, 2015g, "Cuvier's Beaked Whale (*Ziphius cavirostris*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/cuvier's-beaked-whale.html. Accessed March 24, 2017.

NMFS, 2015h, "Dall's Porpoise (*Phocoenoides dalli*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/porpoises/dalls-porpoise.html. Accessed March 24, 2017.

NMFS, 2015i, "Dwarf Sperm Whale (*Kogia sima*)." Updated Dec. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/dwarf-sperm-whale.html. Accessed March 24, 2017.

NMFS, 2015j, "Long-Beaked Common Dolphin (*Delphinus capensis*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/dolphins/common-dolphin_long-beaked.html. Accessed May 11, 2015.

NMFS, 2015k, "Blainville's Beaked Whale (*Mesoplodon densirostris*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/blainvilles-beaked-whale.html. Accessed May 1, 2017.

NMFS, 2015l, "Stejneger's Beaked Whale (*Mesoplodon stejnegeri*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/beaked-whale-stejnegers.html. Accessed March 24, 2017.

NMFS, 2015m, "Northern Right Whale Dolphin (*Lissodelphis borealis*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/dolphins/northern-right-whale-dolphin.html. Accessed May 11, 2015.

NMFS, 2015n, "Pygmy Sperm Whale (*Kogia breviceps*)." Updated Dec. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/pygmy-sperm-whale.html. Accessed March 24, 2017.

NMFS, 2015o, "Short-finned Pilot Whale (*Globicephala macrorhynchus*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/short-finned-pilot-whale.html. Accessed May 11, 2015.

NMFS, 2015p, "Striped Dolphin (*Stenella coeruleoalba*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/dolphins/striped-dolphin.html. Accessed May 11, 2015.

NMFS, 2015q, "California Sea Lion (*Zalophus californianus*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/sealions/california-sea-lion.html. Accessed May 27, 2015.

NMFS, 2015r, "Guadalupe Fur Seal (*Arctocephalus townsendi*)." Updated Jan. 15. Available at http://www.fisheries.noaa.gov/pr/species/mammals/seals/guadalupe-fur-seal.html. Accessed May 11, 2015.

NMFS, 2015s, "Bottlenose Dolphin (*Tursiops truncatus*)." Updated Jan. 16. Available at http://www.fisheries.noaa.gov/pr/species/mammals/dolphins/bottlenose-dolphin.html. Accessed May 26, 2015.

NMFS, 2015t, "Pacific White-Sided Dolphin (*Lagenorhynchus obliquidens*)." Updated Jan. 16. Available at http://www.fisheries.noaa.gov/pr/species/mammals/dolphins/pacific-white-sided-dolphin.html. Accessed May 11, 2015.

NMFS, 2015u, "Northern Elephant Seal (*Mirounga angustirostris*)." Updated Jan. 16. Available at http://www.fisheries.noaa.gov/pr/species/mammals/seals/northern-elephant-seal.html. Accessed May 27, 2015.

NMFS, 2015v, "Risso's Dolphin (*Grampus griseus*)." Updated Jan. 21. Available at http://www.fisheries.noaa.gov/pr/species/mammals/dolphins/rissos-dolphin.html. Accessed May 11, 2015.

NMFS, 2015w, "Short-Beaked Common Dolphin (*Delphinus delphis*)." Updated Jan. 21. Available at http://www.fisheries.noaa.gov/pr/species/mammals/dolphins/short-beaked-common-dolphin.html. Accessed May 11, 2015.

NMFS, 2015x, "Harbor Porpoise (*Phocoena phocoena*)." Updated March 24. Available at http://www.fisheries.noaa.gov/pr/species/mammals/porpoises/harbor-porpoise.html.htm. Accessed May 11, 2015.

NMFS, 2015y, "Baird's Beaked Whale (*Berardius bairdii*)." Updated Sept. 28. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/bairds-beaked-whale.htm. Accessed March 24, 2017.

NMFS 2015z, "Our Living Oceans: Habitat. Status of the Habitat of U.S. Living Marine Resources," NOAA Technical Memo NMFS-F/SPO-75, U.S. Department of Commerce.

NMFS, 2016a, "Blue Whale (*Balaenoptera musculus*)." Updated Feb. 10. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/blue-whale.html. Accessed March 24, 2017.

NMFS, 2016b, "Leatherback Turtle (*Dermochelys coriacea*)." Updated Feb. 10. Available at http://www.fisheries.noaa.gov/pr/species/turtles/leatherback.html. Accessed March 24, 2017.

NMFS, 2016c, "2015-2017 Guadalupe Fur Seal Unusual Mortality Event in California." Updated Feb. 23. Available at http://www.fisheries.noaa.gov/pr/health/immune/guadalupefurseals2015.html. Accessed March 24, 2017.

NMFS, 2016d, "Steller Sea Lion (*Eumetopias jubatus*)." Updated June 17. Available at http://www.fisheries.noaa.gov/pr/species/mammals/sealions/steeer-sea-lion.html. Accessed March 30, 2017.

NMFS, 2016e, "Harbor Seal (*Phoca vitulina*)." Updated Nov. 16. Available at http://www.fisheries.noaa.gov/pr/species/mammals/seals/harbor-seal.html. Accessed March 24, 2017.

NMFS, 2016f, *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts*, Technical Memorandum NMFS-OPR-55, July.

NMFS, 2017a, "Killer Whale (*Orcinus orca*)." Updated Jan. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/killer-whale.html. Accessed March 24, 2017.

NMFS, 2017b, "Humpback Whale (*Megaptera novaeangliae*)." Updated Jan. 10. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/humpback-whale.html. Accessed March 24, 2017.

NMFS, 2017c, "Sperm Whale (*Physeter macrocephalus*)." Updated Jan. 10. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/sperm-whale.html. Accessed March 24, 2017.

NMFS, 2017d, "Bryde's Whale (*Balaenoptera edeni*)." Updated Feb. 8. Available at http://www.fisheries.noaa.gov/pr/species/mammals/whales/brydes-whale.html. Accessed May 1, 2017.

NMFS, 2017e, "Interim Sound Threshold Guidance," West Coast Region. Available at http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html. Accessed July 7, 2017.

NMFS and USFWS (U.S. Fish and Wildlife Service), 2011, "Endangered and Threatened Species; Determination of Nine Distinct Population Segments of Loggerhead Sea Turtles as Endangered or Threatened," *Federal Register* 76(184):58868–58952.

NMFS and USFWS, 2014, *Olive Ridley Sea Turtle (*Lepidochelys olivacea*) 5-Year Review: Summary and Evaluation*, National Marine Fisheries Service, Office of Protected Resources, Silver Springs, MD, and U.S. Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Services Field Office, Jacksonville, FL, June.

NMSP (National Marine Sanctuary Program), 2008, *Channel Islands National Marine Sanctuary Final Management Plan/Final Environmental Impact Statement*, Silver Springs, MD, Nov.

NOAA (National Oceanic and Atmospheric Administration), Marine Mammal Stock Assessment Reports (SARs) by Species/Stock. Available at www.nmfs.noaa.gov/pr/sars/species.htm.

Noble, R.T., S.B. Weisberg, M.K. Leecaster, C.D. McGee, J.H. Dorsey, P. Vainik, and B. Orozco-Borbon, 2003, "Storm Effects on Regional Beach Water Quality along the Southern California Shoreline," *Journal of Water and Health* 1:23–31.

Normandeau Associates, Inc., 2012, *Effects of Noise on Fish, Fisheries, and Invertebrates in the U.S. Atlantic and Arctic from Energy Industry Sound-Generating Activities*, prepared for the U.S. Department of the Interior, Bureau of Ocean Energy Management.

Northridge, S.P., and R.J. Hoffman, 1999, "Marine Mammal Interaction with Fisheries," pp. 99–119 in J.R. Twiss and R.R. Reeves (eds.), *Conservation and Management of Marine Mammals*, Smithsonian Institution, Washington.

NPS (National Park Service), 2017, "Channel Islands National Park, California: Seabirds & Shorebirds." Available at http://www.nps.gov/chis/learn/nature/seabirds.htm. Accessed April 10, 2017.

NPS, 2018, "Guadalupe Fur Seal." Available at https://www.nps.gov/chis/learn/nature/guadalupe-fur-seal.htm. Accessed March 19, 2018.

NRC (National Research Council), 1990, *Decline of Sea Turtles: Causes and Prevention*, National Academy Press, Washington, DC.

PEPC (Plains Exploration and Production Company), 2012a, *Revisions to the Platform Hidalgo Development and Production Plan to Include Development of the Western Half NW/4 of OCS-P 0450, Accompanying Information Volume Environmental Evaluation*, submitted to Bureau of Ocean Energy Management, Pacific Outer Continental Shelf Region, Oct.

PEPC 2012b, *Revisions to the Platform Hidalgo Development and Production Plan to Include Development of the Western Half NW/4 of OCS-P 0450, Accompanying Information Volume Biological Evaluation of Threatened and Endangered Species*, submitted to Bureau of Ocean Energy Management, Pacific Outer Continental Shelf Region, Oct.

PFMC (Pacific Fishery Management Council), 2016a, *Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery.*

PFMC, 2016b, *Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species as Amended through Amendment 3.*

PFMC, 2016c, *Pacific Coast Salmon Fishery Management Plan for Commercial and Recreational Salmon Fisheries off the Coasts of Washington, Oregon, and California as Revised through Amendment 19.*

Pondella, D., J. Williams, J. Claisse, R. Schaffner, K. Ritter, and K. Schiff, 2012, "Rocky Reefs," Volume V in *Southern California Bight 2008 Regional Monitoring Program*. Southern California Coastal Water Research Project, Costa Mesa, CA.

Popper, A.N., A.D. Hawkins, R.R. Fay, D.A. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R.L. Gentry, M.B. Halvorsen, S. Løkkeborg, P.H. Rogers, B.L. Southall, D.G. Zeddies, and W.N. Tavolga, 2014, *Sound Exposure Guidelines for Fishes and Sea Turtles*, ASA S3/SC1.4 TR-2014, prepared by ANSI-Accredited Standards Committee S3/SC1. Available at https://www.researchgate.net/profile/Arthur_Popper/publication/279347068_Sound_Exposure_Guidelines/links/5596735d08ae99aa62c777b9/Sound-Exposure-Guidelines.pdf. Accessed June 14, 2018.

PXP (Plains Exploration and Production Company), 2012, *Revisions to the Platform Hidalgo Development and Production Plan to Include Development of the Western Half NW/4 of OCS-P 0450, Accompanying Information Volume Environmental Evaluation*, submitted to Bureau of Ocean Energy Management, Pacific Outer Continental Shelf Region, Oct.

Ranasinghe, J.A., K.C. Schiff, C.A. Brantley, L.L. Lovell, D.B. Cadien, T.K. Mikel, R.G. Velarde, S. Holt, and S.C. Johnson, 2012, *Southern California Bight 2008 Regional Monitoring Program: VI. Benthic Macrofauna*, Technical Report 665, Southern California Coastal Water Research Project, Costa Mesa, CA.

Reilly, S.B., et al., 2008, "Eubalaena japonica," in *The IUCN Red List of Threatened Species 2008*. Available at http://www.iucnredlist.org/details/41711/0. Accessed Sept. 27, 2015.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson, 1995, *Marine Mammals and Noise*, Academic Press, San Diego, CA.

Riedman, M.L., and J.A. Estes, 1990, *The Sea Otter (*Enhydra lutris*): Behavior, Ecology, and Natural History*, U.S. Department of the Interior, U.S. Fish and Wildlife Service, Washington, DC, Sept. Available at https://www.fort.usgs.gov/sites/default/files/products/publications/2183/2183.pdf. Accessed May 11, 2017.

Rodriguez, D.A., A. Chapman, and R. Cartwright, 2011, *Shorebird Abundance and Distribution on Beaches of Ventura County, California 2007–2010*, BOEMRE OCS Study 2010-24, California State University Channel Islands, Camarillo, CA, Dec.

Sahagun, L., 2008, "Turtles at New Frontier," *Los Angeles Times*, Aug. 30. Available at http://articles.latimes.com/2008/aug/30/local/me-turtles30. Accessed April 27, 2017.

SAIC (Science Applications International Corporation), 1986, *Assessment of Long-Term Changes in Biological Communities in the Santa Maria Basin and Western Santa Barbara Channel: Phase I, Vol. II*, prepared for Minerals Management Service, Pacific OCS Region.

SAIC, 2011, *Final Environmental Impact Report for the Ellwood Pipeline Company Line 96 Modification Project*, Santa Barbara County EIR No. 09EIR-00000-00005, prepared by Marine Research Specialist, Science Applications International Corporation, for County of Santa Barbara, July.

Salmons, J., 2017, personal communication, "Information on Approved APDs and APMS," from Salmons (Environmental Compliance Officer, Office of Field Operations, BSEE Pacific Region, Camarillo, CA) to I. Hlohowskyj (Environmental Science Division, Argonne National Laboratory, Argonne, IL), Oct. 16.

Schiff, K., D. Greenstein, N. Dodder, and D.J. Gillett, 2016, "Southern California Bight Regional Monitoring," *Regional Studies in Marine Science* 4:34–46

Seal Conservation Society, 2011, "Guadalupe Fur Seal (*Arctocephalus townsendi*)." Available at http://www.pinnipeds.org/seal-information/species-information-pages/sea-lions-and-fur-seals/guadalupe-fur-seal. Accessed May 5, 2017.

Seapy, R.R., and M.M. Littler, 1978, "Biogeography of Rocky Intertidal Macroinvertebrates of the Southern California Islands," pp. 307–323 in *Proceedings of 2nd California Islands Multidisciplinary Symposium*.

Širović, A., et al., 2015, "Seven Years of Blue and Fin Whale Call Abundance in the Southern California Bight," *Endangered Species Research* 28:61–76.

Smith, G., C. Stamm, and F. Petrovic, 2003, Haliotis cracherodii. The IUCN Red List of Threatened Species. Available at http://www.iucnredlist.org/details/41880/0. Accessed June 14, 2018.Smultea, M.A., and T.A. Jefferson, 2014, "Changes in Relative Occurrence of Cetaceans in the Southern California Bight: A Comparison of Recent Aerial Survey Results with Historical Data Sources," *Aquatic Mammals* 40(1):32–43.

Sydeman, W.J., et al., 2012, *Hotspots of Seabird Abundance in the California Current: Implications for Important Bird Areas*, March 23. Available at http://www.audubon.org/sites/default/files/documents/report_audubon_ibas_011813.pdf. Accessed August 13, 2015.

Tinker, M.T., and B.B. Hatfield, 2016, *California Sea Otter (Enhydra lutris nereis) Census Results, Spring 2016*, Data Series 1018, U.S. Geological Survey, Reston, VA. Available at https://pubs.usgs.gov/ds/1018/ds1018.pdf. Accessed May 11, 2017.

Tinker, M.T., et al., 2017, *Southern Sea Otter Range Expansion and Habitat Use in the Santa Barbara Channel, California*, Open-File Report 2017-1001. U.S. Geological Survey, Reston, VA.

URI (University of Rhode Island), 2017, *Discovery of Sound in the Sea*. Available at http://www.dosits.org. Accessed March 17, 2017.

USFWS (U.S. Fish and Wildlife Service), 1970, "Title 50—Wildlife and Fisheries, Chapter I—Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Department of the Interior, Subchapter B—Hunting and Possession of Wildlife, Part 17—Conservation of Endangered Species and Other Fish or Wildlife, Appendix D—United States List of Endangered Native Fish and Wildlife," *Federal Register* 35(199):16047–16048.

USFWS, 2006, *Five-Year Review of the California Least Tern (*Sternula antillarum browni*)*, Carlsbad, CA.

USFWS, 2012, "Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the Pacific Coast Population of the Western Snowy Plover," *Federal Register* 77(118):36728–36869.

USFWS, 2016, "Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for the Marbled Murrelet," *Federal Register* 81(150):51348–51370.

USFWS, 2017, "Southern Sea Otter," Ventura Fish and Wildlife Office. Available at https://www,fws.gov/ventura/endangered/species/info/sso.html. Accessed May 11, 2017.

USFWS and NMFS, 1994, "Endangered and Threatened Wildlife and Plants; Final Rule to Remove the Eastern North Pacific Population of the Gray Whale from the List of Endangered Wildlife," *Federal Register* 59(115):31094–31095.

Vanderlaan, A.S.M., and C.T. Taggert, 2007, "Vessel Collisions with Whales: The Probability of Lethal Injury Based on Vessel Speed," *Marine Mammal Science* 23(1):144–156.

Whale Alert—West Coast, 2017, "Channel Islands Region." Available at http://westcoast.whalealert.org. Accessed May 11, 2017.

Zembal, R., B.W. Massey, and J.M. Fancher, 1989, "Movements and Activity Patterns of the Light-Footed Clapper Rail," *Journal of Wildlife Management* 53:39–42.

Zembal, R., S.M. Hoffman, and J.R. Bradley, 1998, *Light-Footed Clapper Rail Management and Population Assessment, 1997*, Report 98-01, California Department of Fish and Game, Bird and Mammal Conservation Program.

Zembal, R., and S.M. Hoffman, 1999, *Light-Footed Clapper Rail Management and Study, 1999*, U.S. Fish and Wildlife Service and California Department of Fish and Game.

Zembal, R., et al., 2016, *Status and Distribution of the Light-footed Ridgway's (Clapper) Rail in California – 2016 Season*, Nongame Wildlife Program 2016-04, Final Report to State of California, Department of Fish and Wildlife, South Coast Region, San Diego, CA, Sept. 15.

APPENDIX B:

ACTIVITIES UNDER THE PROPOSED ACTION THAT REQUIRE AN APPLICATION FOR PERMIT TO DRILL (APD) OR AN APPLICATION FOR PERMIT TO MODIFY (APM)

B.1 CONDUCTOR INSTALLATION

Installation of a conductor is the first step of drilling a new well on the Pacific Outer Continental Shelf (POCS). A conductor provides protection, stability, and structural support to the wellbore, prevents caving of the wellbore, and provides a conduit for the return of drill muds and cuttings to the platform for processing. A conductor typically consists of multiple sections of large-diameter steel pipe (e.g., 26–32 in. [66–81 cm] in diameter) welded together end to end to a desired length. On the POCS, all installed conductors extend from the platform to below the seafloor (Figure B-1), and some total as much as 1,600 ft. (500 m) in length.

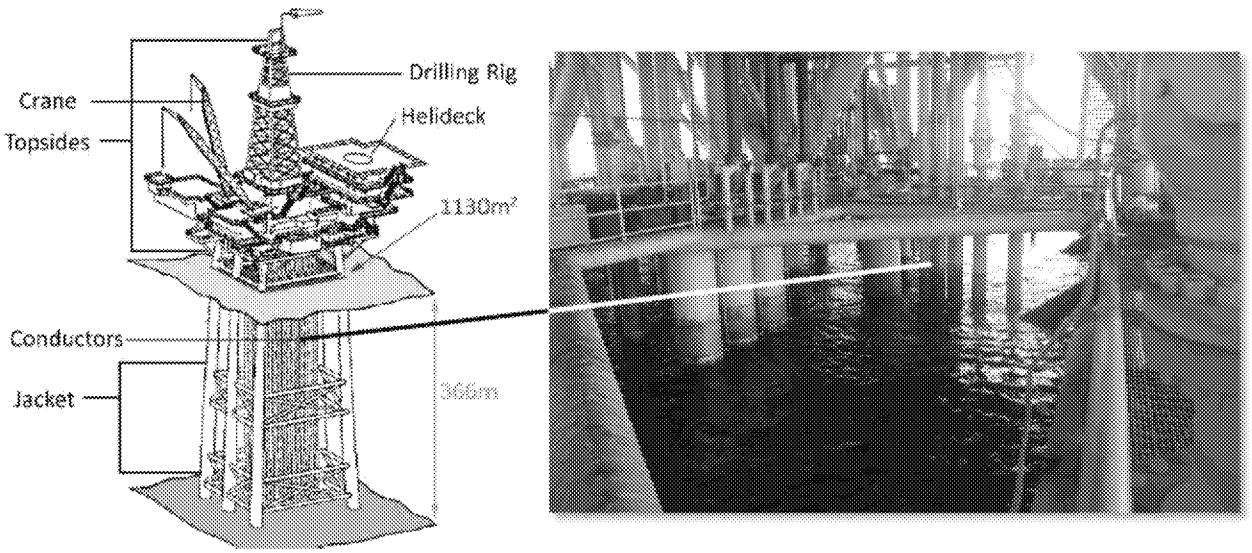

FIGURE B-1 Schematic of General Platform Configuration Showing Platform Area at Sea Level and Water Depth (left), and Photograph Showing Exposed Conductor Pipes and Harmony Platform Infrastructure at Sea Level (right) (NMFS 2014)

Two methods of conductor installation have been employed on the POCS: installation by impulsive hammering, which uses a deck-mounted hydraulic hammer to drive the conductor to its desired depth, and installation by drilling, which uses a jet bit to bore into the seafloor sediment, followed by a conventional bit to drill into the underlying rock. The method used depends on the geologic conditions at the location of the planned conductor installation. The most recent conductor installation on the POCS was at Platform Harmony. Because of the geologic conditions at that location, pipe driving with a hydraulic hammer, also referred to as "pile driving," was

determined to be the only proven conductor installation method that would enable management of potential interferences with the existing platform infrastructure and that would allow the conductor to reach the desired target depth.

In a typical conductor installation by impulsive hammering, installers weld pipe sections together on the platform and lower the lengthening conductor into the water column through a metal conductor guide attached to the jacket structure of the platform. The guide orients the conductor and directs it to a desired location on the seafloor, where the weight of the conductor pipe passively drives the initial seafloor penetration of the conductor. After this, a deck-mounted hydraulic hammer is used to drive the conductor to its target depth below the seabed.

Hydraulic hammering may last several hours for each added section, depending primarily on sediment physical properties, which affect penetration rate. Several cycles of welding (each lasting several hours) and hydraulic hammering are needed for the conductor to reach its target sub-seafloor depth. Thus, active hammering occurs only intermittently and may account for 35 to 40% of the total installation time for a single conductor. Altogether, it may take several days to complete installation. To reduce overall installation costs, operators typically install several conductors sequentially at a given platform. Impulsive conductor installation generally requires little or no increase in platform crew over routine operations, and no noticeable change in routine supply boat or helicopter traffic. However, some additional vessel traffic associated with delivery of conductor pipe sections may be expected.

Where sediment and sub-seafloor conditions are suitable, jet drilling may be used for conductor installation. In such installations, the weight of the conductor is again used to initially embed the conductor into the seafloor sediments. Next, a jet bit inserted to the bottom of the conductor uses high-pressure seawater to further bore deeper into the seafloor with the conductor following. The solids (cuttings) produced by the jet bit are carried up the inside of the conductor by the high-pressure seawater to the platform, where they are collected for processing and disposal. Upon hitting solid rock, a drill bit replaces the jet bit and boring continues to the target depth, again using high-pressure seawater to flush out drilling solids while the conductor pipe follows the drill bit. The installation is completed by cementing the conductor into place. Cement is forced down the conductor, out of the bottom of the pipe, and up the outside of the pipe into the annulus between the conductor pipe and the rock surface of the borehole. The cemented conductor provides a sealed drilling path from the platform deck into the target rock formation.

Conductors may be installed to support immediate drilling of a new wellbore or in anticipation of future drilling at a platform. Only 363 (33%) of the 1,111 total slots on the active POCS production platforms are available for new well drilling, and 305 of these would require conductor installation before drilling could begin (Table B-1). The number of slots for conductor installation varies among the platforms. For example, of the 10 slots available for new well drilling at Platform Eureka, all have previously installed conductors. In contrast, Platform Irene has 40 slots available and no conductors (Table B-1).

TABLE B-1 Open Slots, by Platform, Available for New Conductor Installation and Well Drilling (Platforms Grace and Gail have entered the decommissioning process and therefore are not included.)

Platform Groupings and Platforms	Slots Currently Available for Conductor Installation or Drilling (available/total)	Number of Available Slots	
		With Conductors[a]	Without Conductors[b]
Santa Maria Basin Platforms[c]	140/226 (69% availability)	22	118
Harvest	29/50 (58%)	6	23
Hermosa	32/48 (67%)	16	16
Irene	40/72 (55%)	0	40
Hidalgo	39/56 (69%)	0	39
Santa Barbara Channel—West Platforms[d]	7/148 (5%)	5	2
Heritage	0/60 (0%)	0	0
Hondo	0/28 (0%)	0	0
Harmony	7/60 (12%)	5	2
Santa Barbara Channel—East Platforms[e]	142/525 (27%)	11	131
Gina	3/15	0	3
Gilda	34/96	0	34
Habitat	3/24	1	2
Henry	0/24	0	0
Hillhouse	10/60	0	10
Hogan	26/66	0	26
Houchin	24/60	0	24
A	7/57	5	2
B	10/63	3	7
C	25/60	2	23
San Pedro Bay Platforms[f]	77/212 (36%)	20	57
Edith	50/72	9	41
Ellen	17/80	1	16
Eureka	10/60	10	0
Elly[g]	NA	NA	NA
Total	363/1,111 (33% availability)	58	305

[a] Total number of slots available for new drilling with conductor casing already in place.

[b] Total number of slots available for new drilling without a conductor in place.

[c] Includes Lease Blocks 315, 316, 437, 438, 440, 441, 450, and 451.

[d] Includes Lease Blocks 180, 181, 182, 183, 187, 188, 189, 190, 191 192, 193, 194, 195, 326, 329, and 461.

[e] Includes Lease Blocks 202, 203, 216, 234, 240, 241, and 346.

[f] Includes Lease Blocks 296, 300, 301, and 306.

[g] Platform Elly is a process-only platform, and no drilling or hydrocarbon production occurs there.

B.2 NEW WELLS AND SIDETRACKING

The Proposed Action includes acceptance and review of Applications for Permit to Drill (APDs) for drilling new wellbores beginning at the seafloor, and Applications for Permit to Modify (APMs) for sidetracking from an existing wellbore. These well types are described in the following paragraphs.

B.2.1 New Wells

Drilling a new well includes deployment of a drill string and a casing string, and placement of a wellhead, blowout preventer, and riser connecting the wellhead to the platform. Drilling a new well from a platform can only occur through a conductor, the availability of which varies considerably among the platforms (Table B-1). Drilling proceeds with the installation of a sequence of successively smaller diameter bores as the well accesses greater depths, each with a casing cemented into place (Figure B-2). For each drilled interval, a motor mounted on the platform rotates the drill string. Water-based drilling fluid (i.e., drilling mud) is pumped at a high rate down the drill string and circulates drilling cuttings back up through the casing annulus. On the platform deck, vibrating shakers remove the cuttings from the drilling fluid. The drilling fluid is treated and restored with chemical additives and recirculated in a continuous process. Drill cuttings may be disposed of in an onshore landfill, by reinjection into the formation, or by permitted open-water discharge. On the POCS, spent drilling muds may be disposed of via open-water discharge under the National Pollutant Discharge Elimination System (NPDES) General Permit. Once the producing zone of the formation has been reached, well completion involves installing a slotted casing or perforating a solid casing with a cement sheath in place to allow hydrocarbons to flow to the inside of the well casing, and then installing packers and tubing inside the well casing to conduct oil and gas to the platform surface.

B.2.2 Sidetracking

A sidetrack is a secondary wellbore that is drilled away from an original wellbore to either bypass an unusable section of the original wellbore or to access a nearby productive portion of the formation when production in the original wellbore has dropped below desired levels. It is not uncommon to have multiple sidetracks from a single original wellbore. Sidetracking also requires the permanent plugging (i.e., plugback) of the original wellbore. With sidetracking, there is no new conductor installation, and all drilling and plugback occurs at depths well below the seafloor surface (Figure B-2).

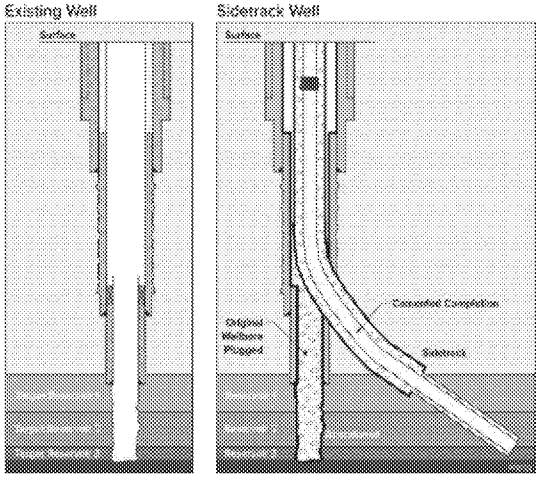

FIGURE B-2 Existing and Sidetrack Wells

B.3 TEMPORARY WELL ABANDONMENT

Temporary well abandonment may occur for a variety of reasons (e.g., for extended well workover or repair), the requirements for which are specified in Bureau of Safety and Environmental Enforcement (BSEE) regulations (30 *Code of Federal Regulations* [CFR] 250, Subpart Q, §250.1721–1723). To isolate downhole hydrocarbons from the surface for temporary abandonment, a plug is set at the base of the deepest casing string and another plug is set no more than 1,000 ft. (304.8 m) below the mud line. Temporary well abandonment uses existing platform infrastructure (e.g., permitted diesel-engine pumps). There were 30 approved APMs for temporary well abandonments at POCS platforms between 2012 and 2017.

B.4 ENHANCED PRODUCTION

The Proposed Action includes two enhanced production operations: (1) well washing and desanding, involving wellhead removal; and (2) artificial lift. A recent Preliminary Environmental Assessment (PEA) addressed review and approval of APMs for acidizing and hydraulic fracturing, which are two other enhanced production activities PEA (BSEE and BOEM 2016). Therefore this PEA does not evaluate these activities.

B.4.1 Well Washing and Desanding

Sand removal is identified in BSEE regulations as a routine operation that generally does not require written approval from the BSEE District Manager (30 CFR 250, Subpart F, §§250.601 and 250.613), and dozens have been performed as routine operations between 2012 and 2017. An APM is not required in cases that do not require wellhead removal, such as those using a coiled-tubing unit. In cases in which wellhead removal is necessary, an APM is required, and such an operation involves temporarily plugging the well and removing the wellhead, which is accomplished using existing platform infrastructure. Sand generated by well washing and desanding is collected on the platform for processing and permitted disposal. There were six approved APMs for well washing/desanding operations at POCS platforms between 2012 and 2017.

B.4.2 Artificial Lift

Artificial lift is the general term for any means used to help bring produced fluids to the surface. The most commonly used offshore artificial lift methods are gas lift and pumps. Both methods use existing platform infrastructure. There were 65 approved APMs for artificial lift operations at POCS platforms between 2012 and 2017.

Gas lift is currently the most widely used approach to enhance oil production. Inert gas is injected into the producing hydrocarbon fluid at high pressure through one or more subsurface gas-lift valves in the well and propels the fluids to the surface. Commonly used gases include CO_2 or natural gas produced from the well. A gas compressor on the platform provides the required pressure to open the gas-lift valves. As the gas enters the tubing, it forms bubbles, which reduce the fluid density. This lightened fluid density, along with the bubbles, forces the produced fluid up

the tubing string to the platform. The gas produced from the well can be separated from the produced fluids and reinjected into the well (this is known as a closed-loop gas lift).

Pumps used for artificial lift at POCS platforms include sucker-rod pumps, hydraulic pumps, progressive cavity pumps, electric submersible pumps (ESPs), and jet pumps. Sucker-rod pumps and hydraulic pumps are similar in operation. Both are placed at the bottom of the tubing string, and each uses a rod-actuated plunger and two or more check valves which control the direction of oil flow. As the plunger moves up and down, oil is drawn in to the pump and then lifted up the tubing. In a sucker-rod pump, the rod extends from the pump to the surface and connects to a pumping unit on the platform. In contrast, the rod in hydraulic pumps is short and extends only to an engine piston that is part of the downhole pump.

Progressive cavity pumps use a rotating helical rotor within a stator (a metal tube with internally molded cavities). The stator is typically run down the bottom of the production tubing, while the rotor is connected to the bottom of a rod string extending from the platform. Rotation of the rod string by means of a drive system on the platform causes the rotor to spin within the fixed stator, creating a pumping action that moves the produced fluids to the surface. With ESP artificial lift, an electric motor-driven pump placed at the bottom of the well pushes production fluids to the surface. Transformers on the platform provide electrical power for the pumps. Sixty APMs for replacing existing ESPs at POCS platforms were approved between 2012 and 2017.

A jet pump powered by a pump on the platform is inserted into the production fluids in the wellbore and injects a pressurized fluid (the power fluid, typically consisting of refined oil, produced water, or a mixture of the two). As power fluid exits the jet pump nozzle at a high velocity, production fluid in the wellbore is passively drawn into a low-pressure section of the pump where it mixes with the power fluid. This mixed fluid then enters another portion of the pump where higher pressure brings the mixed fluid to the surface through a second tubing string. This operation is accomplished using existing platform pumps and infrastructure. The number of existing jet pumps at POCS platforms has been declining, and when one fails it is likely replaced by an ESP. There was only a single approved APM for enhancing production using a jet pump at POCS platforms between 2012 and 2017.

B.5 WORKOVER

The Proposed Action includes two workover operations: tubing changes and casing pressure repair.

B.5.1 Tubing Change

Because tubing size affects the velocity of the fluid flowing up the well, replacing existing tubing with smaller-diameter tubing may improve fluid movement to the surface. A tubing change may also be required because of mechanical issues, such as corrosion of downhole equipment, the collection of debris or scale in the wellbore, and the production of formation sand. Production tubing is suspended from a casing hanger (which is part of the wellhead), and thus can be readily removed and replaced. Prior to removal, a heavy fluid is placed into the well to prevent flow of

reservoir fluids during tubing extraction. The casing hanger is then removed from the wellhead, the tubing string is pulled from the well, and a new tubing string is installed. Tubing changes use existing platform infrastructure (e.g., permitted diesel engines, electric generators). There were 89 approved APMs for tubing changes at POCS platforms between 2012 and 2017.

B.5.2 Casing Pressure Repair

Casing repairs address excessive casing pressure or casing leaks. The method of repair depends on the size and condition of the casing, the depth and extent of the leak, and the productivity of the well. Casing repair techniques include squeezing cement[22] into a problematic void space at a desired location in the well, running a casing liner or patch, and in some cases removing and replacing the casing. Casing repairs use existing platform infrastructure (e.g., permitted diesel engines, electric generators). There were 18 approved APMs for casing repair at POCS platforms between 2012 and 2017.

B.6 UTILITY

The Proposed Action includes two utility operations: the injection of additional fluids in a designated injection well, and conversion of an existing well to an injection well.

B.6.1 Injection of Additional Fluids

In order to increase low reservoir pressures, produced water may be injected into a reservoir. While produced water is the most commonly used injection fluid, other fluids such as brine and polymer solutions may also be injected to enhance hydrocarbon production. Injected fluids become part of the produced fluids and are separated from the hydrocarbon product, reinjected, or disposed of in accordance with the NPDES General Permit for the platforms. This utility operation requires no changes to existing platform infrastructure. There was only a single approved APM for the use of additional injection fluids at POCS platforms between 2012 and 2017.

B.6.2 Conversion of Existing Well (Production Well to Injection Well)

An existing production well can be converted to an injection well, saving the effort of drilling a new injection well. Injection wells are fundamentally the same as production wells, the main difference being the direction of flow. Well conversion requires mounting some directional-flow components that control the amount of fluid injected into the well. Otherwise, no additional platform-based infrastructure is necessary. There were seven approved APMs for well conversion at POCS platforms between 2012 and 2017.

[22] Squeeze refers to the application of pump pressure to force a treatment fluid or slurry into a specific zone within a well. In a cement squeeze, a cement slurry is forced through holes or splits in a casing or liner into the surrounding formation, where the relevant holes and voids will fill with cement that then cures to form an impenetrable barrier.

B.7 COMPLETION

Completion is the process of making a well ready for production (or injection) once drilling has been completed. The Proposed Action includes four completion operations: initial completion, reperforation, perforation modification, and change in the zone of perforation. Completion operations are accomplished using existing platform equipment. Each completion operation includes well perforation to establish hydrocarbon flow between the wellbore and the reservoir. Perforations also provide injection points for enhancing production. Well sections within a reservoir are typically perforated in several intervals with short sections of unperforated casing between intervals.

B.7.1 Initial Completion

Initial completion involves cementing and perforating the well casing, gravel packing, and installing a production tree. As drilling progresses, steel pipe casing is joined together to make a continuous hollow tube (the casing string) that is run into the wellbore. The casing stabilizes the wellbore and, once cemented, isolates different formations to prevent unwanted flow of formation fluid. Cementing the casing involves pumping cement slurry at high pressure down the inside of the casing string and out of the bottom, displacing drilling fluids and filling in the space between the casing and the surrounding rock surface of the wellbore with cement as it rises back up the outside of the casing string. To improve hydraulic performance when drilling deeper wells, liners may be used instead of full casing strings. A liner is a casing string that does not extend back to the wellhead, but instead is hung from another casing string.

The use of shape-charge explosives is the most common method of perforating. Shape charges penetrate well casings and cement with a jet of high-pressure, high-velocity gas. The charges are arranged in a tool called a gun and lowered into the well to the desired depth opposite the producing zone. The charges are then fired by electronic or mechanical means from the platform surface, resulting in several perforations that allow reservoir fluids to flow into the wellbore.

Some wells require gravel packing to prevent sand from entering the wellstream. In such an operation, a slurry of appropriately sized coarse sand or gravel is pumped into the well between the slotted or perforated casing and the sides of the wellbore. The gravel pack filters out sand entrained in the formation fluid before it enters the production stream. There were 23 approved APMs for initial completion at POCS platforms between 2012 and 2017.

B.7.2 Reperforation

Reperforation involves creating new holes within an existing perforated zone of the wellbore, without increasing or decreasing the size of the zone. The process can be performed at any point in the life of a well. There were 27 approved APMs for reperforation at POCS platforms between 2012 and 2017.

B.7.3 Perforation Modification

A perforated zone can become plugged with scale or other solid particles, or become compacted, reducing formation permeability and inflow to the well. In other cases, lower portions of a perforated zone may be primarily producing formation water. To address such issues, an operator may request permission to modify the perforation zone, with the intent of increasing or decreasing the perforation interval. This may involve creating new perforations above or below the existing perforated zone, or squeeze-cementing a portion of a perforated zone to limit inflow of formation water. There were 23 approved APMs for modifying perforations at POCS platforms between 2012 and 2017.

B.7.4 Change in Zone

A zone change (recompletion) involves abandoning one perforated zone and opening another. Recompletion work varies depending on whether the new zone is above or below the currently perforated zone. If above, the lower zone would be abandoned via squeeze-cementing or installing a cement plug or a mechanical bridge plug, and the new zone perforated. If the new zone is below the current zone, the existing zone will probably be squeeze-cemented (in the same manner as repairing casing), the cement in the wellbore drilled out, and the lower zone perforated. There were seven approved APMs for changing perforation zones at POCS platforms between 2012 and 2017.

B.8 REFERENCES

BSEE and BOEM, 2016, Programmatic Environmental Assessment of the Use of Well Stimulation Treatments on the Pacific Outer Continental Shelf, Pacific OCS Regions, Camarillo, CA. Available at pocswellstim.evs.anl.gov.

NMFS, 2014, Issuance of an Incidental Harassment Authorization to ExxonMobil Production Company to Take Marine Mammals by Harassment Incidental to Conductor Pipe Installation Activities at Harmony Platform in the Santa Barbara Channel Offshore of California, Office of Protected Resources, Permits and Conservation Division, Silver Springs, MD.